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New High Strength Aluminum Impact Extrusions

Silver and Gold Plated Parts Meet Tough Specifications

Black Light Spots Defects in Materials

How to Induction Harden Boron Steel Gears

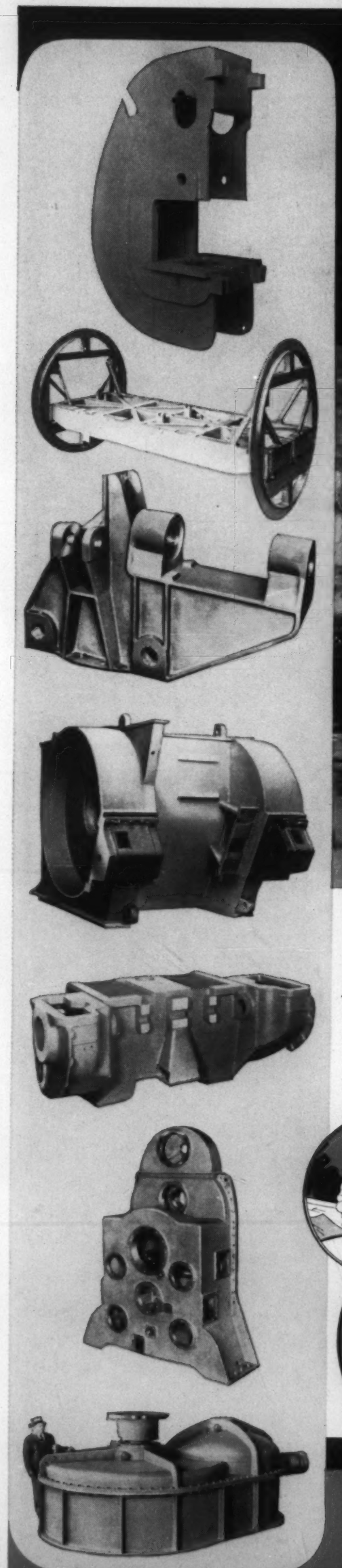
Properties of Lead-Base Babbitts

Delicate Parts Now Embedded in Clear Acrylics

WELDED AND BRAZED PARTS
—Materials & Methods Manual No. 88

NOVEMBER
1952

THE MAGAZINE OF
MATERIALS ENGINEERING
DEVOTED TO THE MATERIALS PROBLEMS OF PRODUCT DESIGN AND MANUFACTURE



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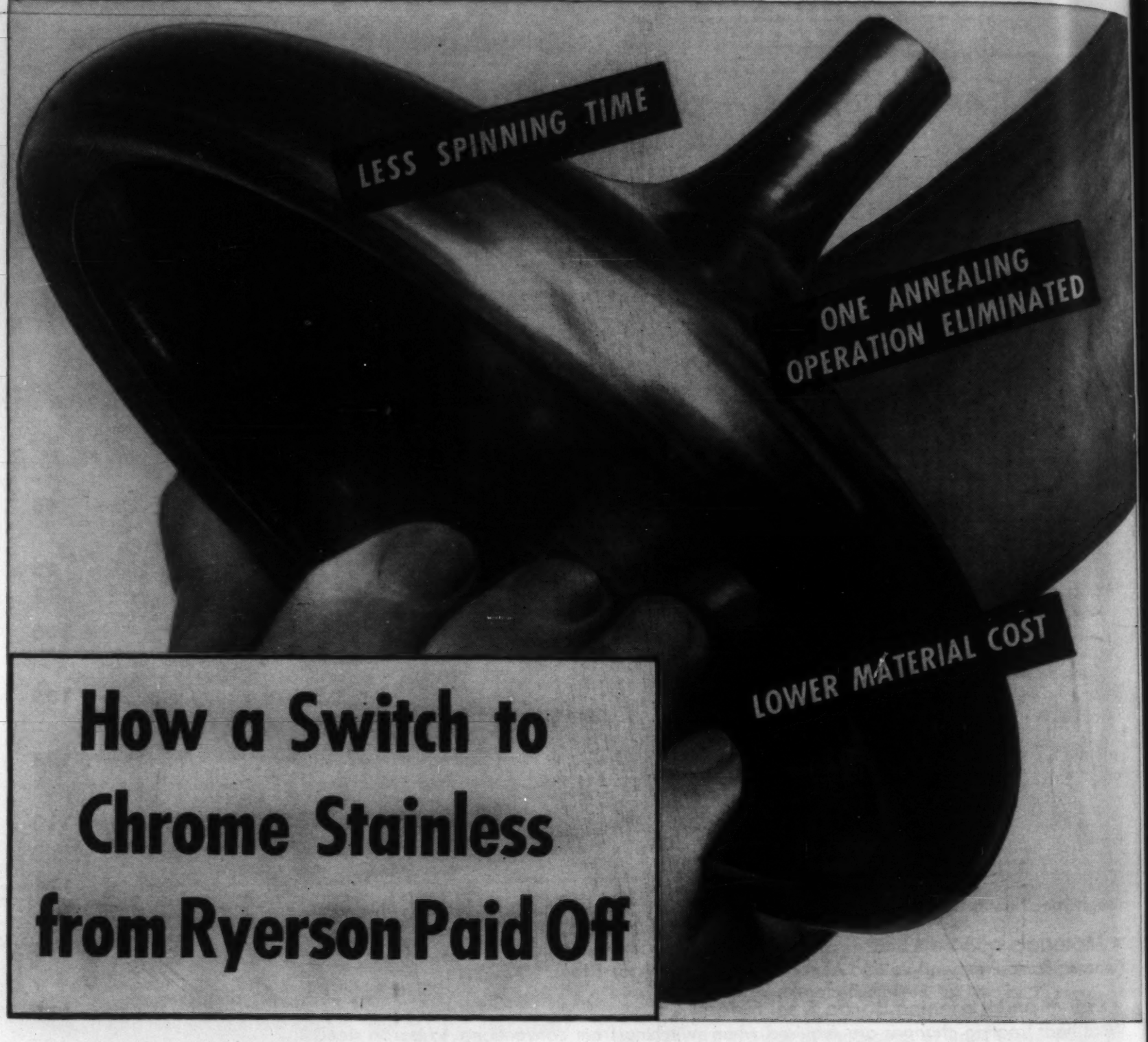

How a Switch to Chrome Stainless from Ryerson Paid Off

Here's how a Ryerson customer kept his business going when NPA Order M-80 cut off his supply of nickel-bearing stainless. This manufacturer was turning out vacuum tops for coffee dispensers. He was using Type 305 nickel-bearing stainless in his product—thought 305 was the only steel for the job. Restrictions on nickel meant discontinuing production or finding an alternate material.

In his search for an alternate, our customer tried Allegheny Type 430 straight chrome stainless from Ryerson stocks. Results were excellent. The straight chrome steel proved more than just acceptable—it did the job in less time, for less money. Because Type 430 work hardens less rapidly, spinning time was substantially reduced and an annealing operation eliminated. And Type 430 satisfactorily met the finish requirements while costing considerably less than the Type 305 it replaced.

* * *

Perhaps Type 430 or some other straight chrome stainless can solve a problem for you. Only a thorough investigation will tell. We are prepared to help you make that investigation—our staff of stainless specialists is at your service. And we are able to supply the needed steel—our stocks of straight chrome types are the nation's largest and most diversified. Since relief from the nickel shortage is still not in sight, we suggest you act now. Call your nearby Ryerson plant for quick action.

PRINCIPAL PRODUCTS: CARBON, ALLOY & STAINLESS STEELS—BARS, STRUCTURALS, PLATES, SHEETS, TUBING, MACHINERY & TOOLS, ETC.

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The Materials Outlook

Special rubber compound makes it possible to operate conveyor belts on inclines up to 42 deg. Constructed with thousands of fingerlike rubber tentacles that grip extremely slipperly materials, this conveyor bolting carries wax-surfaced cartons, ice, tin plate, glass and tile up steel inclines without slipping. The belt flexes over minimum diameters smoothly and easily.

Paint-on welding flux will speed and improve aluminum welding with inert gas process. The inert gas protects upper surface but leaves the bottom open to embrittlement. New flux is designed to give bottom protection. Commercial announcement is expected within a few months.

Impact extrusions of high-strength aluminum alloys are now being used for small, high production aircraft fittings. They are competitive with forgings on a strength basis, show superior surface smoothness and closer dimensional tolerances, and do not require the draft angle necessary with forging. Experience is being accumulated with 61S, 14S and 75S alloys. Extruding difficulties make it advisable to avoid 24S. (See page 110).

Process for melting and casting titanium, zirconium and their alloys has potentialities as a manufacturing procedure for castings ranging from a few grams to several pounds. Uncontaminated castings produced are close enough to final size to be called precision castings. Metal is arc-melted in argon atmosphere, then cast in a vacuum or under argon pressure.

Vacuum forming is growing rapidly as a plastics forming method. Thermoplastic film and sheet materials from 0.001 to 0.125 in. thick can be formed in relatively fast cycles. The big selling point of the process is low mold cost. Only male or female molds are required. Molds are built for about 10% of the cost of conventional compression or injection molds.

Aluminum industry will probably be "scratching for more production capacity" when the nation's economy returns to normal, according to I. W. Wilson, Alcoa president. He is confident that "aluminum has only begun to realize" its ultimate potentials. Building, automobiles, major appliances and the electrical industry are considered as particularly promising for aluminum.

Largest self-contained hydraulic extrusion press—capacity 3000 tons—has been built for magnesium alloys. Design provides stepless adjustment of

(Continued on page 4)

The Materials Outlook *(continued)*

speed from both main operating pulpit and auxiliary control stand at the platen exit.

Navy Metals Radiography Manual, "Reference Radiographs for Inspection of Aluminum and Magnesium Castings," provides basic material for instruction in the interpretation of radiographs. Bureau of Aeronautics contractors concerned with radiographic casting inspection can obtain details on manual from local inspection offices.

Plastics progress was charted by F. C. McGrew of du Pont recently. Simplification of process equipment by reducing overdesign features and designing multiple-purpose units was predicted. Casting and extrusion techniques are due to be used more. An increased number of plastics will be combined with other structural materials like paper, glass and metals.

Hot-hardness tester has been developed by U. S. Steel Co. research men. Indenter tip and metal specimen are enclosed in a laboratory furnace. At the test temperature, weights are applied to balanced ends of a beam above the furnace. A starting switch drops the loaded beam. Inside the furnace this operates a perpendicular rod tipped by the indenter. With the tip and the specimen at the same temperature, greater accuracy is possible.

Sapphire indenter tips are more satisfactory than diamond tips in the U. S. Steel hot hardness tester, incidentally. Diamonds tend to disintegrate after continued use above 1300 F. A sapphire tip has given long service above 1500 F without disintegration.

Special nickel iron alloy lamination and fine wire windings on a nylon bobbin make extreme miniaturization possible in a tiny hermetic transformer. The overall case measures 1/2 by 11/16 by 29/32 in. Mounting is effected through a single threaded stud arrangement, with case tabs to prevent twisting.

New thermoplastic binder fiber is a cellulose fiber coated with cellulose ester. Manufacturer believes its binding, strengthening and hardening properties may be useful in glass fiber, asbestos, plastics, laminates and acoustical industries.

New liquid pickling agent is being investigated by an enameling plant. Agent is used in 20% solution with water. Advantages claimed to date are reduced pickling time, no hydrogen embrittlement and safer handling.

Credit for magnesium-bismuth permanent magnet alloy announced in July "Outlook" does not belong to U. S. Navy, according to British magazine "Metal Industry". C. Guillaud filed French patents on this alloy and process of fabrication in 1939. His U. S. patents were filed in 1946 and granted in Nov. 1951.

FOR A DEPENDABLE HIGH-TEMPERATURE ALLOY

Look to Incoloy

(32 Nickel—21 Chromium)

Incoloy is comparable to Inconel® in resistance to oxidation. It is strong at elevated temperatures and because of its lower nickel content, it is *superior* to Inconel in resistance to sulfur attack.

It is the latest development of the Inco High-Temperature Engineers. *And* its use is permissible for applications described in Schedule C to NPA Order M-80.

It offers good workability and has good welding properties. Incoloy is not embrittled by prolonged heating at intermediate temperatures. It is supplied in the usual mill forms —billets, rounds, flats, hexagons, sheet and strip, tubing and wire.

Of course, Incoloy, like all Inco Nickel alloys, is on extended delivery due to defense orders. Therefore, it will pay you to anticipate your needs well in advance. Give NPA rating and complete end-use information when ordering.

And remember, you can always count on Inco High-Temperature Engineers to help you solve your metal selection problems—write today for a copy of the High-Temperature Work Sheet. It is a simplified form for use in describing your particular material problem.

Incoloy
...for
Heat-Resisting Applications

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The International Nickel Company, Inc.
67 Wall Street, New York 5, N. Y.

Materials Control Orders

A summary highlighting activities of the NPA affecting engineering materials during the period from Sept. 11, 1952 through Oct. 10, 1952.

● **CONTROLLED MATERIALS PLAN**

Reg. 1, Amend 6—This amendment permits those producers, who are eligible to apply the suffix B-5 to ACM orders for steel, to add the suffix to outstanding orders bearing the quarterly identification of the 2nd or 3rd quarters of 1952. Such an addition does not constitute cancellation of the original order and suppliers must treat the order as having a military program identification as of the conversion date. If a supplier has postponed shipment because of the lack of the B-5 symbol, he must reschedule it for shipment as close to the original shipping date as practicable.

● **ALUMINUM (Order M-22)**

Owners or generators of aluminum scrap are no longer required to file form NPAF-152 when making deliveries of more than 20,000 lb of scrap.

● **COPPER (Orders M-16, M-82)**

The basic copper raw materials order M-16 has been amended to permit brass and bronze foundries, wire mills, brass mills and miscellaneous users who receive quarterly allocations of these materials to place advance orders for the delivery of such materials. This order extends to such producers the same privilege heretofore extended to companies receiving monthly allocations. Under an amendment to order M-82, distributors of brass mill products are permitted to sell and accept orders for increased quantities of their products on a single sale and for any item ordered.

The NPA announced recently that it is doubtful whether CMP controls on copper can be abandoned as long as military, defense-supporting and essential civilian requests continue at the present level. No possibility is anticipated of relaxing copper controls or the issuance of new CMP tickets beyond those already issued for the fourth quarter of 1952 or the first quarter of 1953.

● **GRAPHITE (Order M-66)**

This order, which controls artificial graphite and carbon electrodes used primarily in electric arc furnaces and electrolytic cells, has been revoked, thus permitting consumers to obtain their requirements in the open market, within the limits of present inventory regulations.

● **IRON AND STEEL (Orders M-6A, M-24, M-25, M-80)**

The emergency direction to order M-6A, which set a limit of 5000 lb of aircraft quality steel to be delivered by a distributor to any one customer in a month, has been revoked. By an amendment to order M-24, restrictions on the end-use of terneplate have been removed but the status of terneplate as a controlled material is not affected. The change makes available a coated material, now in ample supply, as a substitute for other coated materials which are frequently in short supply. As a result of certain changes in order M-25, greater freedom in the use of tin plate and complete freedom in the use of terneplate are permitted. The changes also upgrade the type of tin plate which may be used to pack certain products. Under an amendment to order M-80, allocation of alloying materials to melters and processors are changed from a monthly to a quarterly basis. Applications for allocations for the first quarter of 1953 should be filed on form NPAF-114 on or before Dec. 7, 1952.

The NPA has announced that military set-asides of bar steel will continue until the end of the emergency, although it is possible that the "all-other" category now included in the current 27% set-aside for the military will be eliminated.

● **MOLYBDENUM (Order M-81)**

Allocation control on the use of pure molybdenum has been eliminated. Neither increase in consumption nor additional applications are permitted under the amendment.

● **NICKEL (Order M-80)**

Anticipated Change: Schedule 1 will be amended to clarify the fact that the restrictions on nickel for permanent magnets are the same as those imposed on cobalt in schedule 2.

● **TIN (Order M-8)**

This order has been amended to permit the use of body solder containing not more than 40% tin in the production of automobiles and trucks.

Anticipated Change: Since larger quantities of tin are being imported, revision or revocation of order M-24 will occur within six months.

● **TUNGSTEN (Order M-81)**

An amendment to this order eliminates allocation control on the use of pure tungsten but does not liberalize the use of this material or increase the permitted consumption.

NPA REGULATIONS

A new application form designed to aid industry and Government in obtaining special priorities assistance needed to expedite the production of equipment for the Defense Department and the Atomic Energy Commission has been issued by NPA.

News Digest

Among the problems faced by titanium users are high cost, lack of full property evaluation and lack of reproducibility of compositions. All these obstacles are being attacked by research. Experience under production conditions is necessary before the metal can come of age, however.

Industry Urged to Use More Titanium

Rapid Increase in Output Predicted. Possible Price Reductions Slated for Next Year

A symposium to acquaint industry with up-to-date practical know-how on titanium and to encourage wider use of the new metal was held at Watertown Arsenal early last month. Sponsored jointly by the Army and a number of New England trade associations, the one-day program attracted over 1000 persons and highlighted talks by authorities on the availability of titanium, its present and potential applications, and its working behavior and characteristics.

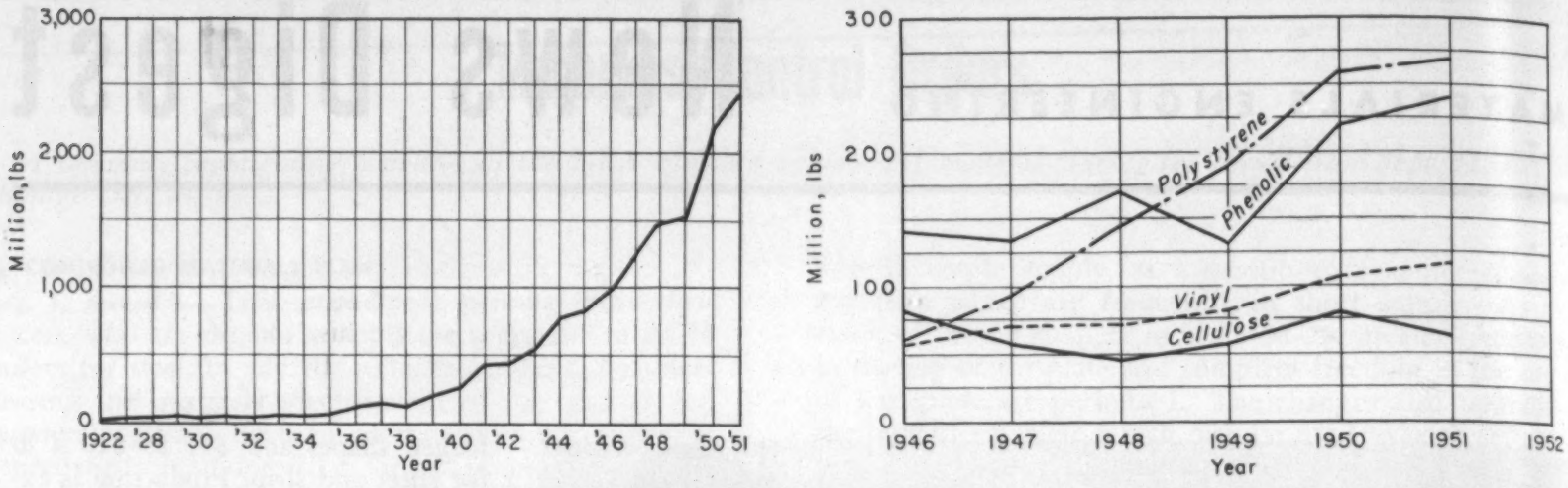
Several of the speakers indicated that some price reductions are likely next year. However, they added that much greater production, stimulated by industry's larger use of titanium in consumer items, would be required before appreciable price cuts could be made. Present prices range from about $6 to $10 a lb for forged shapes and $15 to $20 a lb for sheet and strip. Production is expected to be about 1500 ingot tons this year and at least 3500 tons next year. Titanium ingots now being produced average around 1000 lb. By the end of the year ingots as large as 4000 lb will probably be produced. Increased size of ingots should help lower production costs and thus lower the price of titanium to consumers.

At present, around 90% of the total U. S. titanium production is being used for military purposes, including aircraft, ordnance and naval applications. Ordnance is now testing an 81-mm mortar plate made of titanium. Artillery mounts and frames that are 30 to 35% lighter than steel have been completed and are now undergoing tests at Aberdeen Proving Ground. Reciprocating parts for small arms are also being developed that are 40% lighter than steel and function without deformation.

One of the factors responsible for the high price of titanium is high scrap loss. Col. B. S. Mesick, Commanding Officer of Watertown Arsenal, explained that 50% of the original ingot is now lost as scrap. If means of utilizing this scrap can be found, a considerable reduction in the cost of titanium production would be realized.

In addition to the obstacle of high cost, the speakers stressed that among other problems still existing are a more far-reaching evaluation of properties and a better reproducibility of compositions.

The papers devoted to the fabricating and processing of titanium gave evidence of the large amount of technical data that have already been accumulated. However, the speakers generally agreed that the surface has been barely scratched and that much more work under actual production conditions is still necessary before titanium metal can be relied upon for mass production.



These charts, compiled with the help of the Society of the Plastics Industry and the U. S. Tariff Commission, show growth trends in the plastics industry. The chart at left shows total synthetic rubber production. Figures for four important molding compounds are charted at right.

Atomic Energy Makes New Problems for Industry

Engineers Are Warned Against Getting Caught with Obsolete Plants, Processes or Products

The utilization of atomic energy by industry is so close that businessmen were warned recently to be alert against getting caught with obsolete plants, processes and products. The warning came from P. J. Lovewell, of Stanford Research Institute, Stanford, Calif. Mr. Lovewell was one of ten speakers participating in a symposium on the industrial applications of atomic energy staged as part of the National Chemical Exposition.

Potential developments in atomic power, Lovewell said, will have a major impact on practically every segment of business and industry. Manufacturers, processers and power utilities will be affected first.

"The introduction of atomic power and processes may begin on a modest scale within five years," he predicted. "In ten to 20 years, the effect on business should be sufficient to be generally felt."

Management's problem now, Lovewell continued, is to keep informed as to developments affecting plans and to maintain research programs to protect their competitive interests. Present knowledge must be taken into account in all long-term plans.

"Managements need have no fear that foreseeable developments from atomic energy will replace the economic need for their respective products and services, as the electric light replaced the gas jet. Businessmen must not, however, be caught with obsolete plants, processes or products that place them in an untenable competitive situation."

Present technical developments which will affect business fall into three types, Lovewell said.

First he mentioned the definite possibility of heat-producing atomic reactors for the production of power. This is "perhaps only four or five years away, measured in terms of full-scale producing units," he said.

"Certainly in an industrial economy, nothing is more vital than power supply. The introduction of a vast new potential in power supply, using a fuel so light and compact as to be readily and economically transportable, even to distant locations, could have an almost revolutionary effect on our economy generally. Even the remote possibility of such a thing can well have its effect on the plans of individual businessmen today."

Second, Lovewell continued, there is the potential industrial application of the radioactive by-products of fission now stored as wastes. In five years, commercial applications like high-speed, low-cost industrial radiography and the heatless sterilization of food and drugs are possible. Beyond those lie such developments as portable low-level power sources, improved propagation of flame as in internal combustion engines, and the activation of chemical reactions.

Finally, Lovewell said, there is the use of radioisotopes, already progressing rapidly. These are chemically pure radioactive forms of various elements, made in the atomic pile or separated out of the reactor wastes. They are being used in instruments such as thickness and liquid level gages and density meters, and for activation of phosphors and for static elimination, and in another form as tracers to permit scientists to trace atoms tagged by radioactivity through various processes, industrial or physiological.

There are many other problems raised by these future hopes, Lovewell stated—safety of workers handling radioactive materials, insurance coverage, patent rights and know-how, protection, public relations in overcoming fear of atomic energy rooted in its military uses, shipping and waste disposal, and relations with government, which controls all atomic energy.

Stanford Students Adapt Shell Molding to Small Foundry

College Investigators Groom Process for Western Foundries

Students at Stanford University have pioneered the shell molding process for metal casting that promises big savings for small manufacturers.

When Professor Frank K. Shallenberger of the Stanford Graduate School of Business told them about the shell molds, the students went all out for the idea. Shallenberger had seen the molds used by mass-producing Eastern manufacturers. He believed that shell molds hold great possibilities for small business in the West, too.

The new process calls for a mixture of sand and thermosetting plastic to be brought in contact with a hot metal pattern. The hot pattern cures the adjacent sand, forming a thin, rigid shell or mold. Molten metal is poured into two such shells clamped together.

The result is a metal casting of greater precision and smoother surface—at less cost—about 30% less. The light shells are easier and cheaper to handle and store. Close tolerances and excellent finish on the castings eliminate much machining.

The students' initial move was to visit Western foundries to check on their interest in it.

"It's okay for Ford and other mass producers but not for the job shop foundry," was the usual answer. Or "We're too busy now to experiment with something new." A few did not know anything about it.

So the students took the idea into their own Industrial Laboratory at Stanford for a closer inspection. In place of their pilot-line projects of the past, in which they'd learned by actually manufacturing motors, broilers and such items, they undertook development of a machine to adapt the shell-molding process to typical small foundry operations.

And they succeeded. Six months ago their highly efficient machine produced what are believed to be the first shell molds made in the West.

Its design is simple. The machine could be built at a fraction of the cost of those in use in the East, Professor Shallenberger thinks. Or it could be easily duplicated in any welding and steel fabrication shop. And it can be made fully automatic.

Many Western firms, and others as far away as Pennsylvania, have evinced sharp interest.

Up to now, most companies using the process have kept their operations under wraps. Actual production know-how has been hard to come by. By contrast, Stanford is willing to share all of its shell-molding knowledge and experience with interested firms.

Radioisotope Used in Constant Light Source

Tritium—a product of the Oak Ridge atomic reactor—is being used by two Boston scientists to make a substantially constant light source. A quantity of radioactive tritium is incorporated into stilbene, a crystalline substance, and processed chemically to form a solid crystal. The tritium constantly gives off beta rays which cause the stilbene to fluoresce. Because of this, the new crystals, according to Dr. Irving A. Berstein and Earle Farmer, Tracerlab scientists who developed the process, yield almost constant luminosity and yet have essentially no health hazards.

"Although light from the tritiated stilbene is visible to the eye," Dr. Berstein said, "the maximum light output is strongest in the region where the eye is least sensitive and where all phototubes are most sensitive. The new source will be useful for calibrating instruments containing phototubes which have to be standardized periodically. They will also be valuable to astronomers and scientists who need a constant light source for optical research."

The brightness diminishes about

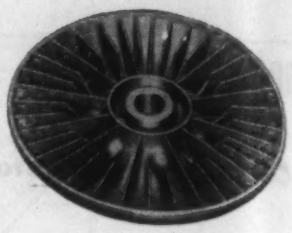
(Continued on page 13)

News Digest

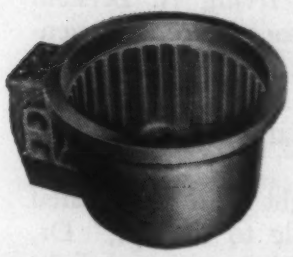
Matter of Fact
BY EDWARD A. JOSEPH
AN ELECTRIC COMPANY CLAIMS A
NEW ALLOY
PERMITS THE MANUFACTURE OF STEAM TURBINE GENERATORS WHICH ARE
35 PER CENT
MORE POWERFUL THAN ANY OF THEIR TYPE NOW IN EXISTENCE
THE ALLOY... IS COMPOSED OF ALUMINUM, WITH SMALL QUANTITIES OF IRON, MAGNESIUM AND SILICON
THERE ARE MORE THAN 300
RUBBER
PARTS ON AN AUTOMOBILE
THEY MAKE UP A VOLUME AND WEIGHT ABOUT EQUAL TO
TWO AUTOMOBILE TIRES
THE NEW CASTING MATERIAL KNOWN AS ML ALUMINUM FOR USE IN ELEVATED TEMPERATURES HAS PROPERTIES APPROXIMATELY
ONE THIRD
BETTER THAN EARLIER ELEVATED TEMPERATURE ALUMINUM ALLOYS
IT REQUIRES MORE THAN 38,000 STEEL BOLTS, NUTS, SCREWS AND RIVETS OF HIGH TENSILE STRENGTH TO HOLD TOGETHER THE FRAMING MEMBERS OF AN AVERAGE SIZE DIESEL RAILROAD LOCOMOTIVE

creative castings

Motor End Frames

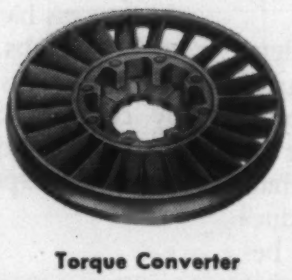


Gyrol Fluid Coupling

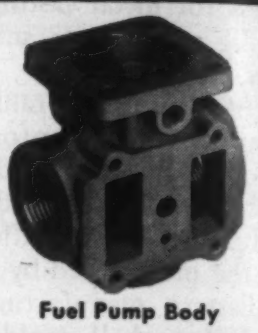


Garbage Disposer Housing

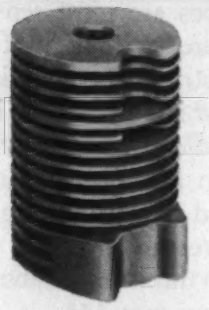
Aircraft Piston



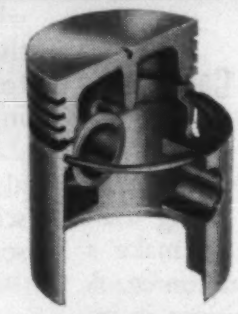
Torque Converter



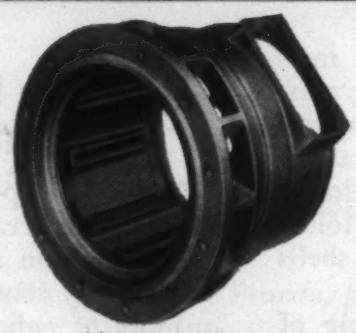
Fuel Pump Body



Carbon Pile Regulator



Steel-Belted Piston



Alternator Housing

Diesel Permanent Mold Piston

Wing Actuator

Air Connector

Launching Barrel for Bazooka

For many years the foundry of Thompson's Light Metals Division quietly cast thousands and thousands of hard-to-make precision parts in light alloys of aluminum and magnesium for customers in the automotive and aircraft fields.

Then word got around in other industries that Thompson had the experience and facilities to cast light-weight, strong, heat-resisting alloy parts in permanent molds and high pressure dies—which eliminated the weight problems of ferrous counterparts. One by one manufacturers of widely different products came to Thompson for help and advice when they learned that the close tolerances achieved by Thompson cut machining and finishing costs.

Today, our capacity is channeled to top-rated jobs. We're building additional facilities as fast as possible and, in the meantime, Thompson services, as always, are at your command. Our entire staff of creative engineers is ready to help you plan new parts or re-design old ones for the future.

YOU CAN COUNT ON...

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2269 Ashland Road • Cleveland 3, Ohio

LIGHT METALS DIVISION

News Digest

continued from page 11

5% each year. It is expected that the lamps will retain over 50% of their light output even after 10 years of use. Radium-activated sources, of the type now used, lose half their light in three to six months.

Work is in progress on the preparation of other nonhazardous, tritiated, self-luminescent materials which will be far more visible to the human eye. These materials, according to Dr. Berstein, will be useful for luminous markers, watch dials, and many other applications for which hazardous radium-activated substances are now commonly used.

Big Dies for Big Forgings

Representing the trend toward bigger dies for producing larger one-piece forgings for aircraft, this huge die block is made by Heppenstall Co. Weighing 44,600 lb, the die block is 6 ft, 10 in. wide, 12 ft high, and 13 in. thick. It is made of Hardtem, a special alloy steel developed by Heppenstall.

(More News on page 190)

unique

AGITATOR DESIGN

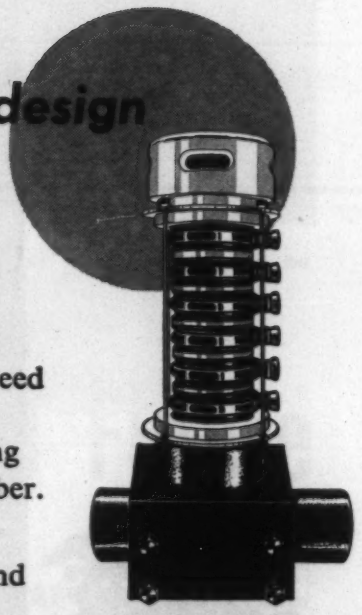
...another example of good design

***with* ACE® HARD RUBBER**

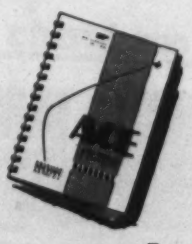
By rapidly removing spent plating solution from the surface being plated and continuously replacing it with live, up-to-formula solution, this impressive "Speed-O-Plate" Agitator makes possible amazing speed in lead coating aircraft bearings. Alsop Engineering Corporation licked the corrosion problem by making this model "Speed-O-Plate" entirely of Ace hard rubber.

Blocks, cylindrical sections, bolts and nuts are all machined from Ace sheet, pipe or rod. Agitators and spray heads are molded. Steel shafts are covered with tubing. Even the motor couplings use hard rubber – for electrical insulation.

In your work, too, you'll often find the properties you're looking for in one of the many Ace hard rubber and plastic compounds. These properties – together with page after page of design hints for mechanical, electrical and chemical parts – are covered in the new Ace Handbook. Keep it always under your thumb. If you haven't a copy, write today.



View of plating station. Six bearings are positioned in hard rubber "stacks" mounted on plating head.



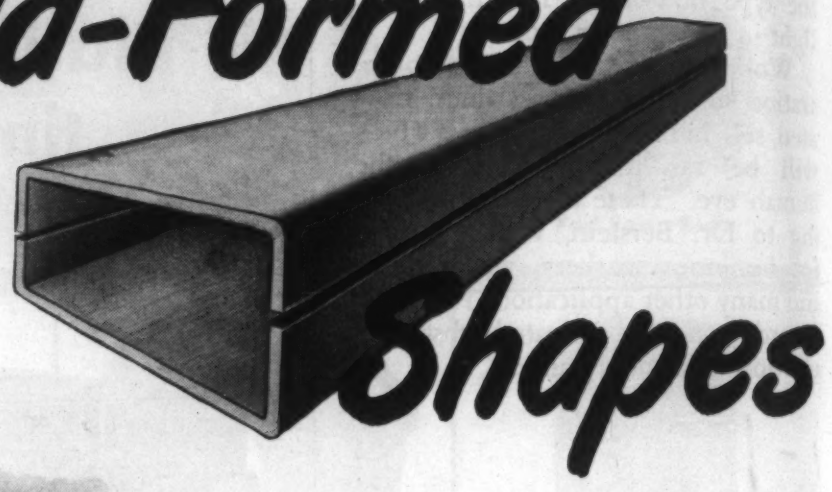
ACE rubber and plastic products

AMERICAN HARD RUBBER COMPANY

93 WORTH STREET • NEW YORK 13, N. Y.

These sturdy sign supports were made from

Cold-Formed Shapes



Strong, attractive signs used by Cities Service have pedestal poles made from Bethlehem Cold-Formed Shapes.

In making these pedestal poles we cold-formed tapered channels from rugged 10-gage sheets, then machine-welded two channels together, forming the rectangular pole. In addition, we provide the base, with holes for anchor bolts, and the base cover.

Poles for gasoline station signs are only one example of the growing variety of parts and products made from Bethlehem Cold-Formed Shapes. Lately we've formed, and in some instances fabricated, shapes for such diverse uses as door tracks, radiant baseboard sections, storage racks, and hatch covers for seagoing vessels. Manufacturers in widely separated fields often come up with ideas for new applications.

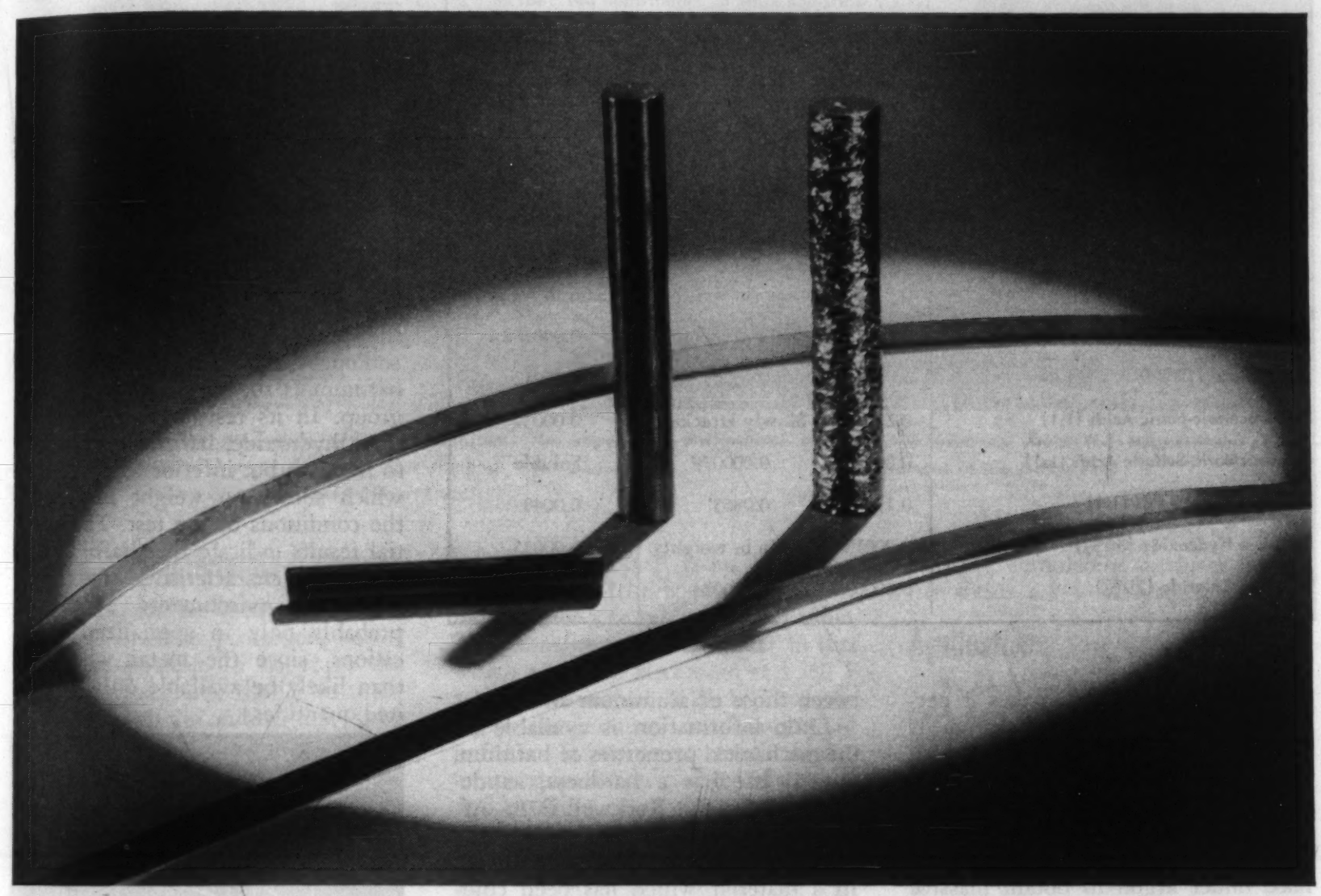
Bethlehem Cold-Formed Shapes are regular or irregular shapes formed cold from strip, sheet or plate steel. They are uniform in thickness, with a surface relatively free from scale. They have a high strength-to-weight ratio. We make them on presses, brakes or rolls in all gages from 5 to 24.

Perhaps there's a place for Bethlehem Cold-Formed Shapes in your business. Why not talk it over with a Bethlehem engineer?

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

BETHLEHEM STEEL



Hafnium crystal bar (right) is melted in an arc furnace under an argon atmosphere to obtain the crude bar (left) which can be rolled into rod or strip.

Hafnium Metal—Its Properties and Future

by **JOHN L. EVERHART, Associate Editor**

Just emerging from the laboratory, hafnium in ductile form is already being used in atomic energy projects . . . . Other applications sure to develop as its characteristics become better known.

● IN RECENT YEARS, a series of new metals has been produced in ductile form. Some, like titanium and zirconium, have reached the commercial stage, others are just leaving the laboratory. Among the latter is hafnium, a metal isolated and named only 30 years ago, a laboratory curiosity two years ago, and now in production by the iodide process in rods weighing up to 12 lb.

Hafnium and zirconium occur together in ores, the hafnium content of the ore generally ranging from 0.2 to 15% of the zirconium content. Many of the properties of hafnium and zirconium are quite similar, and separation is difficult but can be accomplished by chemical means. After such separation, metallic hafnium is obtainable by the methods which are used for zirconium; that is, by the iodide and Kroll processes. Iodide hafnium contains less than 1% zirconium, and the properties and characteristics discussed in the following sections were determined on this material.

Like zirconium, hafnium combines readily with all but the noble gases. Oxygen dissolves in the metal, and,

Relative Corrosion Resistance of Hafnium, Zirconium and Titanium (Foote)

Corrosive Medium	Corrosion Rate, In. Penetration per Year		
	Hafnium	Zirconium	Titanium
Sulfuric Acid (96.2%)	Soluble	Soluble	0.17
Sulfuric Acid (10%)	0.00035	0.000036	0.00032
Hydrochloric Acid (37%)	0.0013	0.00061	Soluble
Hydrochloric Acid (10%)	0.00035	0.000012	0.00025
Nitric Acid (Fuming)	0.00044	Gain in weight	Gain in weight
Nitric Acid (69.7%)	0.00018	Gain in weight	0.000264
Nitric Acid (10%)	0.00035	0.000012	0.00012
Hydrochloric-Nitric Acids (1:1)	0.13	Slowly attacked	0.00039
Hydrochloric-Sulfuric Acids (1:1)	0.00048	0.000079	Soluble
Nitric-Sulfuric Acids (1:1)	0.19	0.0865	0.0048
Sodium Hydroxide (50%)	0.00018	Gain in weight	0.00035
Sodium Chloride (20%)	0.000088	0.000024	0.000018

in sufficient quantities, makes it permanently brittle. Since hafnium is so reactive no deoxidizers are known and careful melting practice is necessary to obtain ductile material. The crystal bar obtained in the iodide process can be melted in an arc furnace under argon to obtain massive hafnium suitable for further working. After the metal has been obtained in massive form, the rate of oxidation is sufficiently low to permit hot working in air. By a combination of hot and cold working procedures, the metal has been produced in the form of sheet and wire.

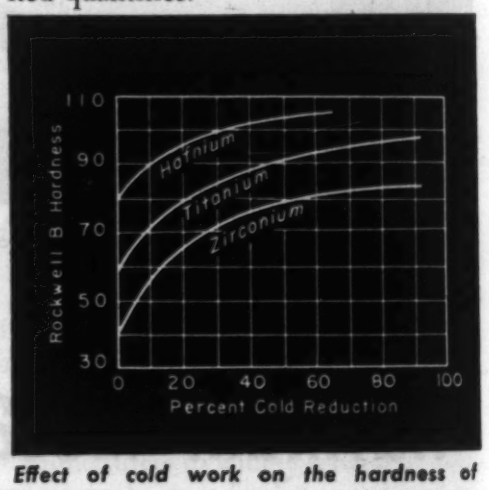
Properties

Some of the properties of iodide hafnium are given in an accompanying table, which includes also properties of zirconium and titanium for comparison. All three of these metals have melting points considerably higher than those of the more common constructional materials, with hafnium having the highest melting point of the three. The density of hafnium is roughly twice that of zirconium and is somewhat greater than that of lead. Although the electrical conductivity of hafnium is only 6% of that of copper, it is twice as good a conductor as titanium and somewhat better than zirconium. Its modulus of elasticity is the highest of the three metals and is roughly halfway between those of aluminum and steel.

Little information is available on the mechanical properties of hafnium. Crystal bar has a hardness, as deposited, of about Rockwell B78. After arc melting and annealing, the material has about the same hardness. In a material which has been cold-worked to 60% reduction, the hardness increases to B102.

The oxidation resistance is important for determining suitable conditions for hot working and possibly for elevated temperature service. Tests made in still air showed that at 1380 F hafnium and zirconium oxidized at approximately the same rate, but at 1650 F the rate of oxidation of hafnium was only about half that of zirconium.

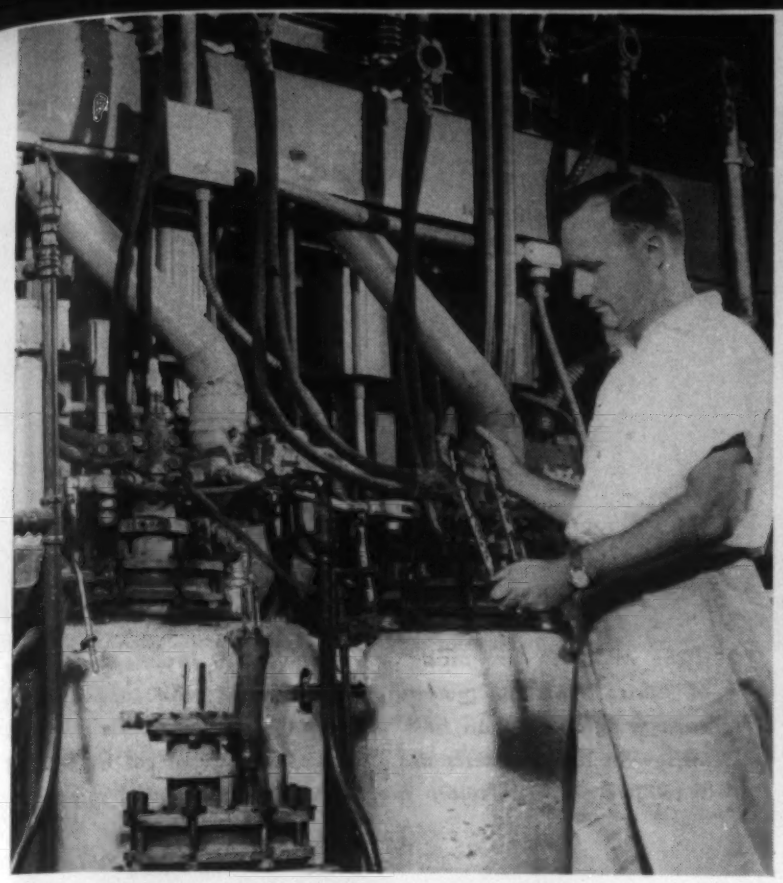
The corrosion resistance of the new metal is still under investigation. The rates of corrosion of hafnium, zirconium and titanium in some solutions are given in an accompanying table. In general, in its resistance to mineral acids, hafnium more nearly resembles titanium than zirconium However, all three materials are approximately equally resistant to 10% sulfuric acid while hafnium is superior to the others in resistance to a one-to-one mixture of hydrochloric and sulfuric acids. All three metals show excellent resistance to a 20% sodium chloride solution, although hafnium is the least resistant of the group. In its resistance to 50% sodium hydroxide, hafnium is superior to titanium but inferior to zirconium, which shows no weight loss under the conditions of the test. These initial results indicate that hafnium has promising characteristics for use in corrosive environments although probably only in specialized applications, since the metal will more than likely be available only in limited quantities.



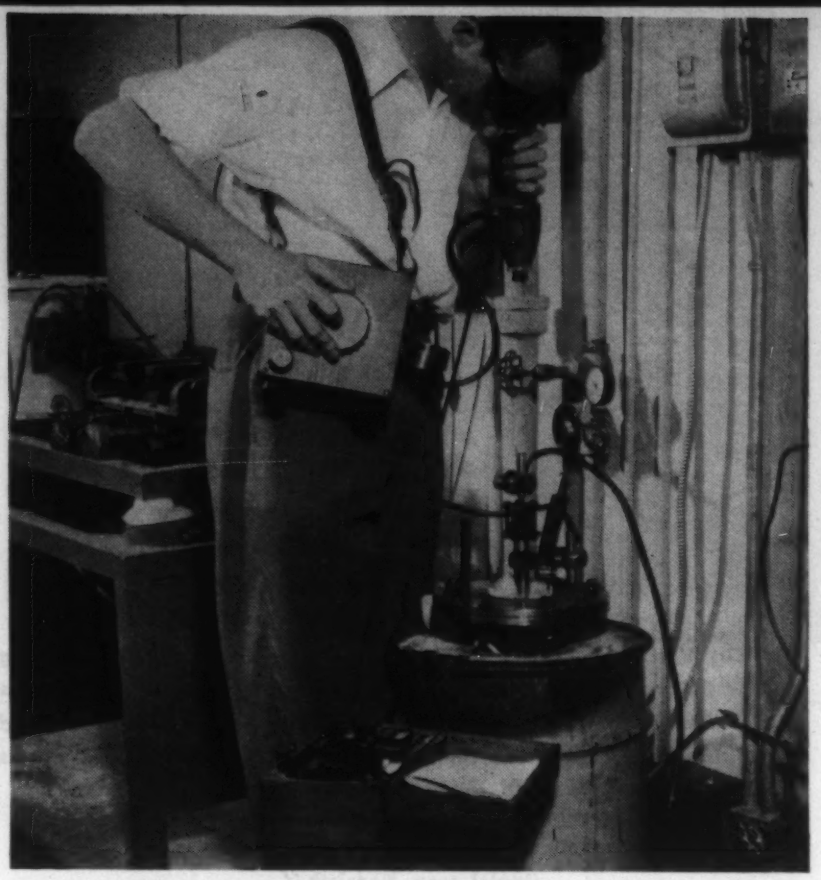
Effect of cold work on the hardness of iodide hafnium, zirconium and titanium. (Litton)

Comparative Properties of Hafnium, Zirconium and Titanium

	Hafnium	Zirconium	Titanium
Density Lb/Cu In.	0.47	0.24	0.16
Melting Point F	3590	3355	3140
Therm Cond Btu/Sq Ft/Ft/Hr/F at 212 F	——	9.6	8.1
Coef of Exp per F at 70 F	3.4×10^{-6}	3.1×10^{-6}	5.0×10^{-6}
Spec Ht Btu/Lb/F	0.035	0.069	0.13
Elec Resist Microhm-Cm	30	40	60
Elect Cond, % I.A.C.S.	5.7	4.3	3.1
Mod of Elast (Tension) Psi	20,000,000	14,000,000	15,000,000



Bank of cells for the production of iodide hafnium. The supervisor holds a crystal bar produced by this method. (All photos courtesy of the Foote Mineral Co.)



An optical pyrometer is used to check the temperature of the filament in the iodide cell.

Forming Characteristics

Hafnium can be hot worked in air at 1650 F without protection, and it should be possible to hot-forge the metal by procedures similar to those employed with zirconium; that is, by using light blows of the hammer to prevent cracking.

An indication of the relative work-hardening of hafnium, zirconium and titanium can be obtained from the accompanying graph. Although hafnium is harder and somewhat more difficult to work than zirconium, cold-working to a maximum reduction of 30% between anneals is possible. No information on the cold forming characteristics is available, but it is probable that the metal can be bent, deep-drawn and formed by slight modifications of the methods used for zirconium. Such procedures would have to be less drastic than those used for zirconium to compensate for the fact that hafnium is a harder material. The crystal structure of hafnium is similar to that of magnesium. Metals with this structure are less easily worked than metals having structures like those of iron or copper. As in the case of zirconium, the workability of hafnium should be improved by raising the temperature to about 400 F. In the limited machining operations which have been performed on hafnium, tooling similar to that used for machining 18:8 stainless steel has been satisfactory.

Heat Treatment

The crystal structure of hafnium changes at 2400 F from hexagonal close packed (the room temperature modification) to body centered cubic. This transformation is similar to that which occurs in zirconium at 1580 F and in titanium at 1625 F. Thus, the room temperature modification of hafnium is stable to much higher temperatures than that of zirconium and titanium.

Cold-worked hafnium can be completely recrystallized by heating to 1435 F. Annealing should be carried out at a somewhat higher temperature, for example, 1550 F. The rate at which oxygen is absorbed is sufficiently low to permit annealing operations on heavy sections to be carried out in air. For very light sections, annealing in a protective atmosphere is preferable.

Cleaning and Finishing

Degreasing can be done by the usual methods in conventional equipment. Scale resulting from air annealing can be removed by sand blasting or sodium hydride descaling. These operations can be followed by dipping the material into a nitric-hydrofluoric solution if a bright finish is desired. A similar solution can be used to remove slight surface discoloration.

Joining

Hafnium can be joined by methods similar to those used for zirconium. Thus, welding can be done by arc or flash-butt procedures in inert atmospheres. However, the weld area must be completely shielded if ductile welds are to be produced.

Applications

As occurs with the introduction of each new metal, suitable applications appear only after its characteristics have been fully evaluated. Up to the present time, no commercial applications have been developed for hafnium except in the atomic energy program, where specific applications have not been revealed. It has been suggested for use in electronic tubes; and alloys of hafnium containing copper, silver and nickel have been produced by powder metallurgy methods.

Acknowledgment

The assistance of the Technical Staff of the Foote Mineral Co. in preparing this article is gratefully acknowledged.

References

Felix B. Litton, "Preparation and Some Properties of Hafnium Metal", *J. Electrochemical Society*, Vol. 98, p 488, (1951).

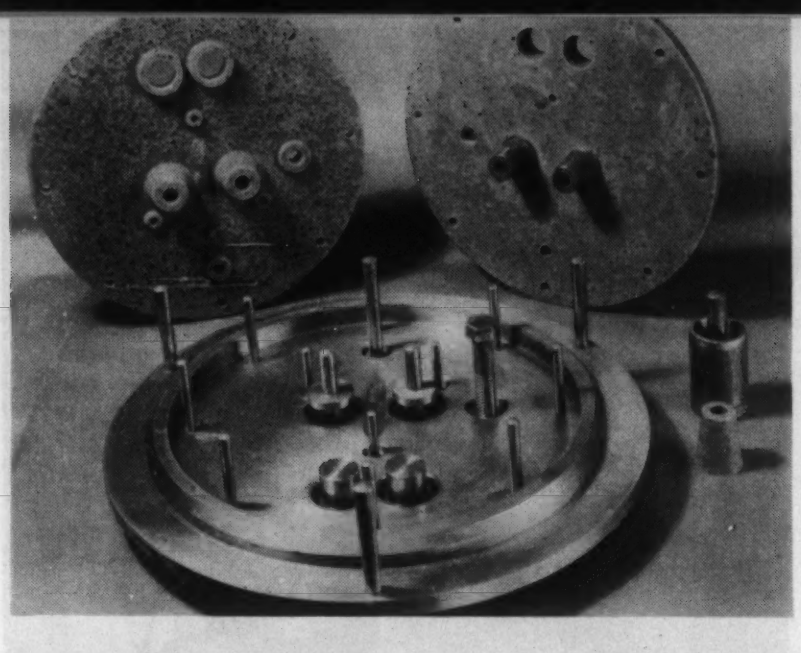
H. K. Adenstadt, "Physical, Thermal and Electrical Properties of Hafnium and High Purity Zirconium", paper presented at midwinter meeting of American Society for Metals, Pittsburgh, Jan 31-Feb 1, 1952.

D. R. Martin, "Hafnium", *Foote Prints*, Vol 21, No. 1, p 8 (1949).

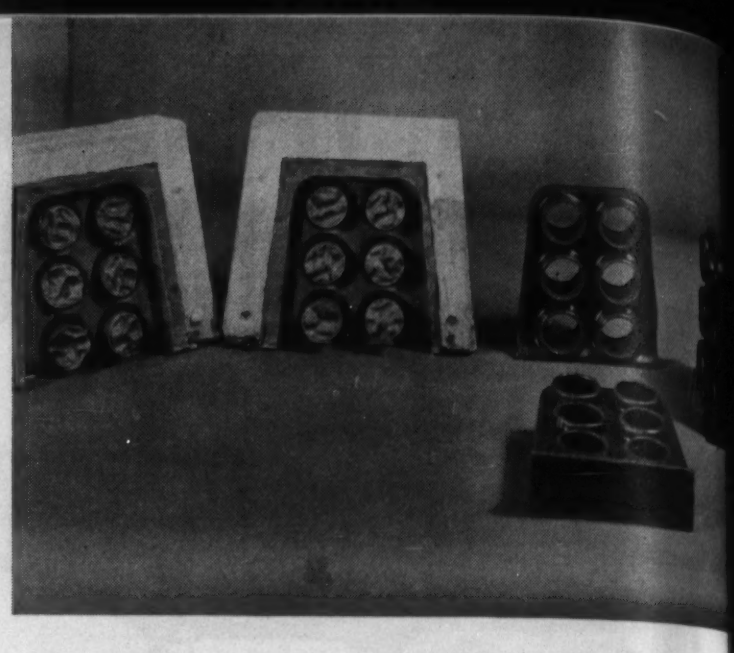
W. J. Kroll, "Production and Uses of Rare Metals", *Mining & Metallurgy*, Vol 27, p 262 (1946).

Alloys Ltd., French patent 835, 468, Dec 22, 1938—*Chem Abstracts*, Vol 33, p 4576 (1939).

P. Duwez, "The Allotropic Transformation of Hafnium", *J. Applied Physics*, Vol 22, p 1174 (1951).



A HIGH VOLTAGE TRANSFORMER cover now costs $4.00, a saving of $16.00 over the previous molding compound. Cover also weighs 50% less. Previous material was difficult to machine and required porcelain insulators and assembling under pressure. Picture shows the cover and its mold as well as an insulator and its mold.



HOSE MOUNTS are made in rubber mold; jacketed in plaster of Paris. Finished mountings (right) cast with tapped holes; each weigh less than half what the previous porcelain mountings with metal inserts did. The cost has been cut from $2.75 to 30¢. The porcelain mounts often cracked and chipped.

In These Applications, Thick Polyester Parts Sav

● IN ITS OWN experimental plastics laboratory during the past two years, the Induction Heating Corp. has developed a low-cost, time-saving method for casting relatively thick polyester parts for the company's own electronic equipment. Laminac 4116 polyester resin, supplied by American Cyanamid Co., is being used. The method has proved so successful that the company has made arrangements to custom mold similar parts for other manufacturers.

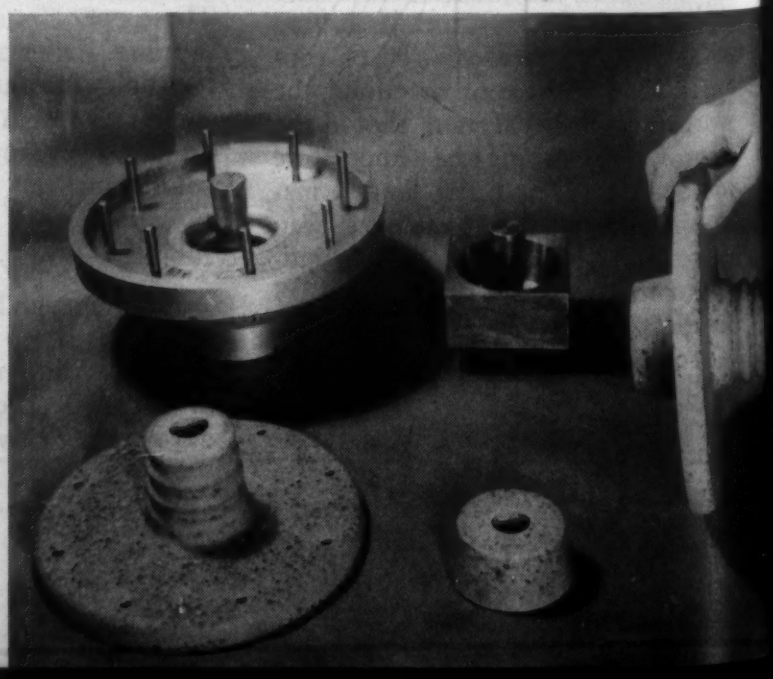
Thermosetting polyester provides the features essential to electronic and electrical components. The moisture resistance of the plastic is high and it is an excellent insulator. Power factor and dielectric constants are low, while the voltage breakdown strength and arc resistance are high. In addition, embedded parts are protected from shock and vibration, as well as from corrosive fumes and atmospheres.

Together with the polyester resin, which is a rigid, very stable material, chopped mica or glass fiber is used as a filler. These combinations minimize shrinkage and reduce exothermic heat during the curing process. Machined steel, rubber, plaster or reinforced polyester molds are used.

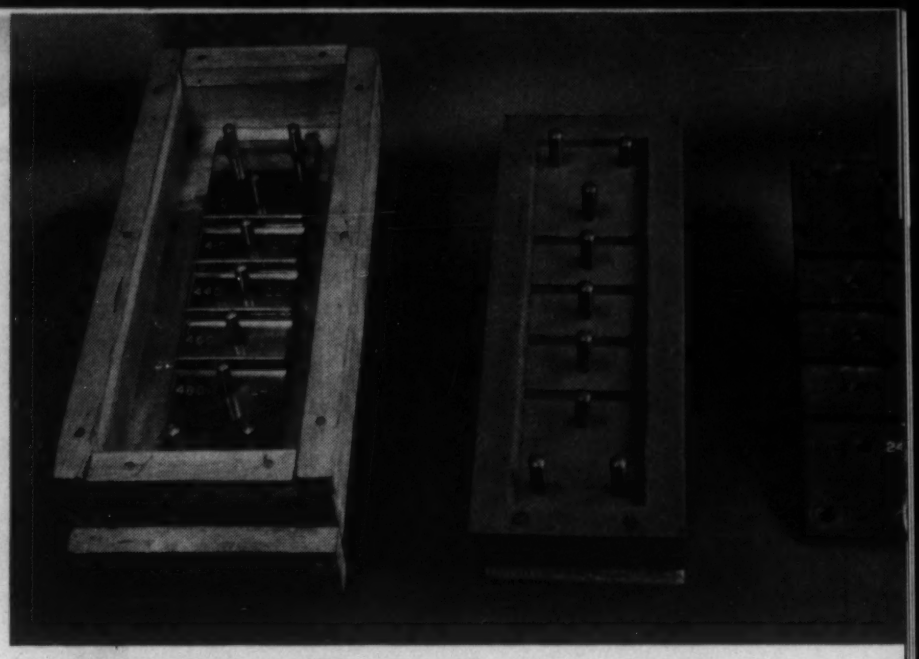
The catalyst used to cure the polyester resin at room temperature is Lupersol DDM, a solution of meythl ethyl ketone peroxide. Although an accelerator is incorporated in the resin as it is supplied, small amounts

DRIP PAN COIL (center) is made by placing vinyl hose and polyester supports in a metal mold (left) and filling the mold with reinforced polyester. This gives a more compact unit than previous coils which employed rubber hose with porcelain supports. Embedding also gives better electrical properties, stops dust from collecting on tool bends, and reduces the danger of stray currents and arcing. Heat-insulating filler and metal supporting inserts are used.

TANK CONDENSER BUSHING PLATE costs less and is made 48 times faster than previously used porcelain plates. The porcelain parts tended to crack when they were screwed down tight. The two parts are now made in steel molds, then bonded with polyester adhesive and oven-cured.



NIPPLE WATER JACKET is made by embedding vinyl tubing with reinforced polyester supports (above) in mica-filled polyester by the open mold process. Condensation and stray currents are prevented when the jacket is mounted on the side of a generator.



TERMINAL STRIP for electrical transformers. A metal pattern is put into a wooden frame (left). Molten rubber is poured over the pattern and allowed to cool. This makes a flexible mold (center), which is put on a plaster base and equipped with taper pins. Reinforced polyester is poured into the rubber mold, flush with the top, and cured at room temperature, to give the finished part (right).

Save Money . . . Reduce Weight

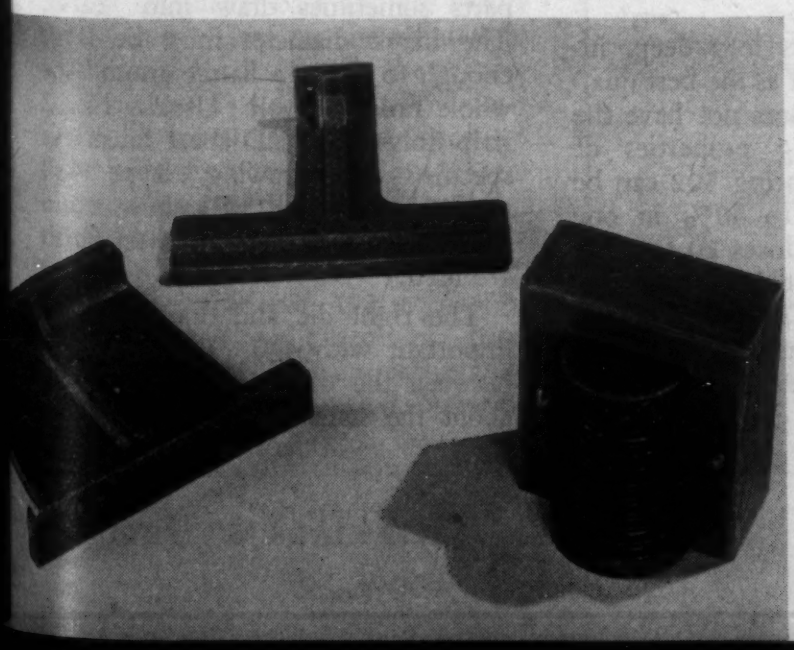
by E. S. GOODRIDGE,
President, Induction Heating Corp.

of cobalt napthenate can be used to further accelerate the cure. Luperco ATC, a readily soluble paste form of benzoyl peroxide, is an effective catalyst at higher temperatures. It is used to insure a crisp, hard cure. Castings are occasionally post-cured in an oven to obtain optimum electrical properties rapidly and to eliminate the possibility of changes due to aging. The resin employed is not sensitive to air and can be cured completely in an open mold.

A variety of parts made in this way have been used successfully to replace parts made of porcelain, brass and inorganic base molding compounds. The molded polyester parts require no filing, buffing, grinding, drilling or engraving. Parts which were previously made separately and then assembled can now be molded in one piece.

In typical applications, a better quality product is obtained with faster, cheaper production. A high-frequency output panel, when it was made of another molding compound, required machining and drilling and the attachment of four porcelain insulators. The molded polyester panel now used has countersunk holes and two insulators molded in. The previous cost was $4.50. The present cost is approximately $1.00. Similarly, a mounting bracket which now costs $.40, was priced at $3.00 when a bronze casting and porcelain insulators were used. A tank condenser bushing plate is now produced 48 times faster than when it was made of porcelain.

MOUNTING BRACKET at left costs $1.25, replaces two porcelain insulators which cost $6.00. The center bracket replaces a bronze casting and a porcelain insulator at a reduction in cost from $3.00 to 40¢. The high voltage switch insulator at right is molded in one piece to replace a porcelain unit which required a cemented-in brass top that was liable to breakage.



AIR VENT DUCTS cost about $1.00. Previous vents cost about $5.00 and required machining and assembly not necessary with the plastic units. Plaster of Paris molds (center) are used.

Type 430 chromium stainless steels can be welded by any method except forge welding, but welded joints may be somewhat brittle at room temperatures. Weld ductility can be improved by reducing heat input during welding, by using 430-T, a titanium stabilized chromium stainless variation, by annealing the welds, and by using a chromium-nickel weld metal.

How to Fabricate 17 Percent Chromium Stainless Steel

by **RICHARD E. PARET**, Stainless Steel Specialist, American Iron & Steel Institute

Type 430 stainless is becoming increasingly popular in product manufacture. To successfully apply it, you must be familiar with its fabricating properties, which differ from those of type 302 it frequently replaces.

● LONG USED FOR automotive and architectural trim, nitric acid processing equipment, combustion chambers and sewing machines, Type 430 17% straight chromium stainless steel is now going into dishwashers, laundry equipment, business machines, air filters and preheaters, electrical terminal boxes, refrigerator evaporators and restaurant equipment of all types. Type 430 fills gaps caused by restrictions on nickel bearing stainless steels.

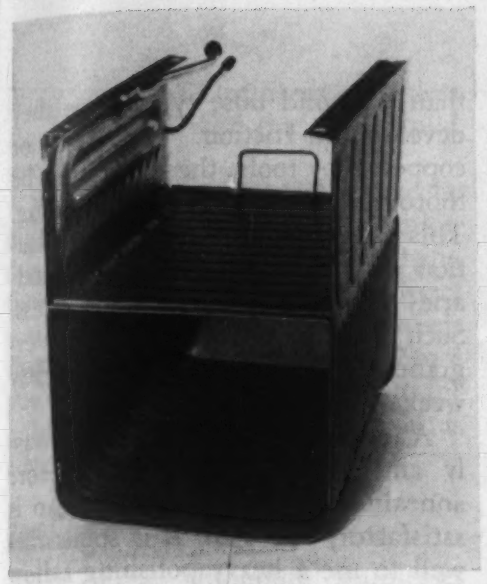
Using straight chromium stainless steels to replace 302 requires analysis of production methods, as well as consideration of service needs. Type 430 has its own properties and its own fabrication techniques. In the annealed condition, the per cent elongation of 302 is almost twice that of 430. The spread between tensile and yield strengths is smaller in 430, and the range of plastic deformation is reduced. Fabricating practices must be modified in order to switch from nickel-bearing 302 to 430 successfully.

Drawing

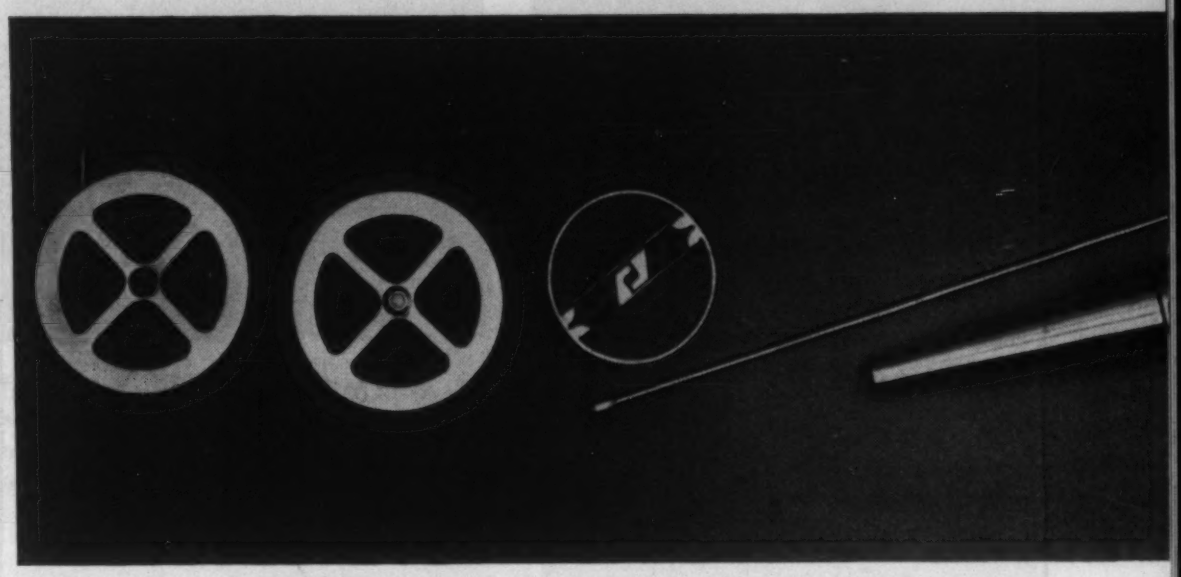
While 430 draws into deep, intricate shapes as well as the best quality carbon steel, it does not have the outstanding drawing properties of 302. The nickel-bearing 302 can be reduced up to 35 to 40% in one draw. Type 430 reduces 20 to 25% on the first draw, and 15% on subsequent operations. Cracks in the side walls or a "ropy" surface texture may result from too severe reductions. Annealing between draws, when required with 430, is carried out at 1400 to 1500 F, never above 1550 F. Parts can be cooled rapidly. Drawing 430 is easier if the metal is warmed before working. Some manufacturers suggest dipping blanks in boiling water. In any event cold stock should be brought up to room temperature before drawing.

Blank size and shape, temper and finish are important in drawing. With 430, it may be necessary to use larger blanks than with 302. The straight chromium stainless tends to stretch locally. Because of the directional properties of 430, the flange on round parts sometimes draw into "ears". The blank diameter must be large enough to retain a flange around the whole finished shell. Usually No. 2 strip finish (No. 2D sheet finish) is specified for drawing. Type 430 yields sharply and will show strain lines if No. 1 or No. 2B sheet finish are used.

The right die and draw ring are important with 430. The clearances between the die and the punch are about the same as for mild steel—



REFRIGERATOR EVAPORATOR once made of 302 stainless steel now uses 430-T for the outer sheet, the shelf and the back plate. Inner sheet is still made of 302, since silver solder brazing of copper tubing to 430-T proved unsuccessful.



COFFEE MAKER uses 430 stainless steel parts for the upper bowl. Durable, corrosion resistant, easy to clean, these parts will in no way alter the flavor of the beverage.

somewhat less than those allowed for 18:8 stainless. Radii should be more liberal than, sometimes even double, those used for 18:8. Dies should be designed for a spring-back allowance 2 to 3 times that specified for mild steel. Solid dies of non-deforming high carbon, high chromium tool steel are most satisfactory. Ordinary cast iron dies wear rapidly and are suitable only for short runs. Chromium and nickel alloy cast irons are good, however. Hard cast bronze is suggested for draw rings. This has less tendency to gall or seize the metal. The radius of the draw ring should be larger than with mild steel. The ring should be well polished and buffed. Oil stones and kerosene, rather than abrasive cloth or similar materials, should be used to remove metal adhering to the draw ring or pressure pad after drawing.

A lubricant of high film strength and adhesive quality should be applied before the blank is put in the die. The lubricant is applied uniformly by brushing, swabbing, spraying, dipping or rolling manually or mechanically. Most good stainless drawing lubricants contain either an oil or animal fat base and are highly sulfurized. They can be diluted to the proper consistency for the particular operation. A light, shallow draw calls for a water-soluble solution. A heavy draw requires an oil-soluble solution. Latex or plastic-based coatings sometimes applied to the blank protect the finish and act as a lubricant.

For the most part, 430 requires no more rugged equipment or press power than 302. Pressure pads should be more carefully adjusted, however, to exert enough force on the blank to prevent wrinkling, but not so much as to prevent flow. This usually requires a double acting press. Forming tools, such as brakes and presses, rated at a definite capacity for mild steels, are usually suitable for stainless steels of about one-half as thick.

Spinning

Type 430 does not work harden as fast as 302. This is an advantage in spinning. The metal can be spun to rough shape, then drawn. Television viewing tubes are made in this way from a modified 430 with a coefficient of expansion close to that of glass.

A variety of spinning tools can be used. Ordinary cast iron tools are satisfactory, but a nickel-chromium-iron (3 carbon, 2.5 to 3 nickel, 0.75 to 1.00 chromium, 1.20 to 1.50% silicon) treated for maximum hardness, is recommended. The tool should be about the same as that used for copper. It should be somewhat flatter, with a greater bearing surface. Roller tools are generally more satisfactory

Typical Mechanical Properties, Annealed Sheet

Type	302	430	430-T	430-F*
Ultimate Tensile, Psi	90,000	75,000	65,000	80,000
Yield Strength, Psi	40,000	45,000	45,000	55,000
% Elong. in 2 In.	50–50	25	30	25
Hardness, Rockwell	85B	85B	78B	107**

** These values for bar stock, since this is a free machining variety of stainless.*
*** Brinnell.*
The fatigue strengths of 302 and 430 are approximately ½ the tensile strengths.

Mechanical Properties of 430 Fusion Welded Joints

Base Metal Type	Welding Process	Filler Metal Type	Condition Prior to Testing	Tensile Test Results: Ult Tens Str, Psi	Tensile Test Results: Elong % in 2 In.	Tensile Test Results: Location of Fract	Guided Bend Test (deg)
430	Oxy-acetylene	430	As welded	72,400	6.3	HAZ	15
			Annealed	68,200	7.0	HAZ	50
	Metal-arc	430	As welded	76,000	15.6	BM & WM	15
			Annealed	73,900	30.0	BM	180
		308	As welded	76,100	26.3	BM	85
	Inert-arc	430	As welded	74,400	26.6	BM	38
			Annealed	72,000	28.4	WM & BM	180
		308	As welded	74,400	23.6	BM	85–180
430-T	Metal-arc	308	As welded	71,800	25.6	BM	180
	Inert-arc	None	As welded	70,700	25.0	WM	180

HAZ—Heat Affected Zone
BM —Base Metal
WM —Weld Meta

These figures are the results of specific spot tests and are not necessarily to be regarded as the rule.

Typical Comparative Analysis (%)

Types	430	430-F	430-T	302
Carbon	0.12 max	0.12 max	0.10 max	0.08–0.20
Manganese	1.00 max	1.25 max	1.00 max	2.00 max
Silicon	1.00 max	1.00 max	1.00 max	1.00 max
Phosphorus, Sulfur or Selenium	—	0.07 min	—	—
Chromium	14.00–18.00	14.00–18.00	16.00–18.00	17.00–19.00
Nickel	—	—	—	8.00–10.00
Molybdenum or Zirconium	—	0.06 max	—	—
Titanium	—	—	0.30–0.70	—

Cutting Rates for Stainless Steels

(Surface Feet per Minute)

AISI Type Numbers	430, 430-T	430-F	301, 302, 304
Brinell Hardness Ranges	170–230	170–230	150–250
Automatic Screw Machine	90–100	120–150	70–90
Heavy Duty Single or Multiple Spindle	80–100	110–130	60–80
Turret Lathe	80–100	110–130	60–80
(Based on tungsten or molybdenum high-speed tooling. Rates can be increased 15–30% with high-cobalt or cast alloys.)			
Automatic Screw Machine (Swiss Type) (Based on carbide tooling)	250–400	250–400	300–400
Milling	70–105	110–135	35–65
Reaming	—	—	—
Smooth Finish at 0.003- to 0.0075-In. Feed	20–60	30–120	20–60
Threading	10–25	10–25	10–25
Tapping	10–25	15–40	10–25
Drill Press	35–75	60–90, 70–115	15–40
(Based on tungsten or molybdenum high-speed tooling)			
Roughing	200–400	200–400	200–350
Finishing	200–400	200–400	300–400
(Single point turning carbide tooling)			
Roughing	100–130	100–150	100–130
Finishing	100–150	150–200	100–150
(High-cobalt or cast alloy tooling)			
Roughing	80–100	120–150	60–90
Finishing	80–100	100–150	40–85
(Tungsten or molybdenum high speed alloy tooling)			

Weld Metal Properties, Type 308 vs Type 430*

Conditions	17% Cr, Type 430 Weld Metal		20-10 Type 308 Weld Metal
	As-Welded	1450 F Annealed	As-Welded
Tensile Properties:			
Ultimate Tensile Str, Psi	95,000	75,000	90,000
0.2% Yield Str, Psi	ND	50,000	55,000
Elongation in 2 In.	3	28	40
Charpy Impact:			
Key-Hole Notch, Ft, Lb	1	20	30

** Properties are those of weld metal deposited by metal arc. These figures are results of specific spot tests and are not necessarily regarded as the rule.*

than the solid nose type, since they develop less friction. With brass or copper alloy tools, the work must be thoroughly cleaned before annealing. This prevents intergranular penetration of the zinc along grain boundaries during the annealing process. Such penetration may cause intergranular checks or cracks, and greatly weaken the structure.

A lubricant must be used generously and completely removed before annealing. Yellow or naptha soap is satisfactory for 430. It is sometimes well to use a heavy polishing tallow in conjunction with the soap. Other recommended lubricants are oil based (heavy stock), and white lead and linseed oil mixed to medium paste consistency (lighter gages).

Spinning completely destroys any surface finish. No. 1 pickled finish is preferred for spun parts. A bright finish, such as No. 2B, will not retain the lubricant as well.

Heavier equipment is required to spin 430 than to work ordinary steels. Spindle speeds must be reduced to approximately two-thirds those used for mild steels. As a rule, 430 can be spun about one-third as much as mild steel before an anneal is required.

Shearing and Blanking

There is no problem in shearing or blanking in converting from 302 to 430. Both types require smaller clearances than ordinary steels. Blades and dies must be closely adjusted and as sharp as possible. In shearing a narrow margin off light gage sheet, a dull blade may drag and turn over the edge instead of parting the margin cleanly. There is one advantage to 430. It breaks after 50 to 75% of its thickness is cut in shearing. Chromium-nickel stainless must be cut almost clear through.

For annealed stainless, the capacity of a sheer will be 50 to 75% the thickness it can handle in mild steel. And as a general rule, a shear should have a capacity in mild steel four or five gages heavier than the stainless

Typical Machinability

Type of Steel	Approx. Surface Ft per Min
Bessemer Screw Stock	165
Type 430-F	120–150
Type 430	85–115
Type 302	40–85
Type 303	85–120

being sheared. Ordinarily, stainless requires about twice the power mild steel does.

Straight chromium stainless steels, unlike the chromium-nickel grades, can be blanked or punched by setting the dies the same as for ordinary steels. The best grade of tool steels should be used for the dies. More power is required for 430 than for mild steel, and slower operation is advisable.

Bending

The 17% chromium stainlesses show directional properties according to the direction in which the sheet is rolled. A bend made parallel to the rolling direction may break in lock seaming, for example. Severe bends should be made across the rolling direction.

If possible, radii twice as large as those allowable with 18:8 should be used with 430. A 90-deg bend usually gives no trouble on 18 gage or light sheet. "Orange peel" effects may occur with sharp radii, however, especially with heavier sheet. This danger can be minimized by an inside radius of one metal thickness or more. A 180-deg bend can usually be made on 18 gage or lighter sheet if the bend is across the rolling direction. If the bend is parallel to the rolling direction, the inside radius should be at least one metal thickness. This means that there should be room for two thicknesses of metal in the bend. On material heavier than 18 gage, 180-gage bends require a radius of at least two metal thicknesses if the bend is across the rolling direction and at least four if it is parallel to the rolling direction.

Machining

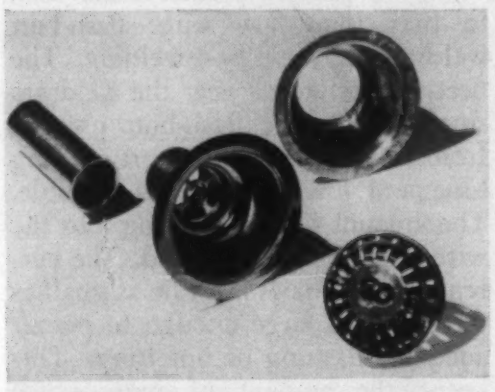
Type 430 stainless is easier to machine than 302. Even so, there is a tendency to gall or build up on the cutting edges of the tool. This will cause high tool pressures, high temperatures at cutting point, and a torn finish. Chips produced are brittle and stringy. Galling can be reduced greatly by using tools sharply ground to a fine finish.

Just as 302 has its easy machining variant in 303 however, so 430 has such a variant in 430 F. Type 430 F is one of the best machining stainless steels. It is used successfully on automatic screw machines. Like 430, it cannot be hardened by heat treatment. It can be annealed to around 170 Brinell, but best machinability is obtained at approximately 228 Brinell. Chips are short and brittle, and chip control is relatively easy.

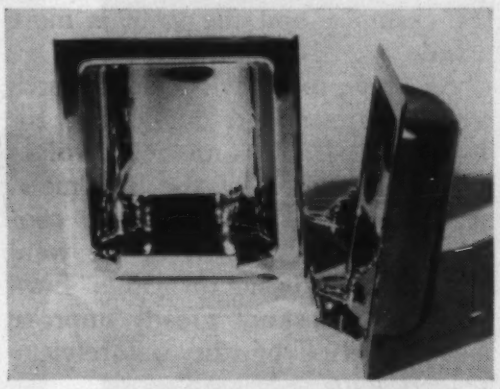
In general, high-speed or carbide tools should be used. Power must be sufficient to maintain constant feeds and speeds. For carbide tooling, oversize motors on all equipment may be required. Tools and tool holders must be highly rigid. Turning tools should be ground with a moderately heavy side rake of 8 to 15 degrees to allow for freedom of cut. A bright top surface on the tool will aid in preventing chip build-up. For drilling, the point should be 140-deg. It may sometimes be necessary to use a chip breaker in drilling to aid in curling the chip. Threading tools should be ground wth 10- to 15-deg back hook to ease the cutting pressures and improve the machined surface. Sulfurized cutting oil is recommend for all threading operations.

It is usually desirable to follow machining with a treatment in 10 to 20% nitric acid plus 2% copper sulfate at 140 to 160 F. This removes small particles of steel and prevents dulling of the stainless surface. The acid dip is followed by a thorough water wash. Heat treatment may be desirable to relieve residual stresses in the metal. Prior to heat treatment all lubricants must be removed.

***TELEVISION TUBES** are made of 430. Relatively heavy metal rings are needed at both ends—on the front where viewing screen is sealed and at the small end where the electron gun is secured. The cone between can be relatively light gage. This combination, impractical in stamping, is achieved by spinning first, then drawing to the modified rectangular shape.*



***SINK STRAINER** parts made of 430 chromium stainless steel. These parts were all formerly made of 302. When chromium-nickel stainless steels were allocated to defense needs, conversion was made to 430.*



***BATHROOM FIXTURES** made of 430 chromium stainless steel are attractive, durable, easy to clean and maintain. Type 430 stainless is currently available for non-defense purposes.*

Welding

Type 430 welded joints may be brittle at room temperatures because of grain growth caused by high welding temperatures. Weld embrittlement is also caused by the formation of brittle martensite around the grain boundaries at high temperatures. Annealing at 1400 to 1500 F will temper the martensite and partly alleviate the brittle condition. It will not correct grain growth, however, and the weld will not be restored to the full ductility of the base metal.

The use of 430-T (430 Ti) improves weld ductility and is being increasingly specified for welding applications. The titanium contained in this grade inhibits the formation of martensite so that welds are fairly ductile in both the as-welded and annealed conditions.

Weld ductility can also be improved in 17% chromium steel by reducing the heat input during welding. This limits the grain growth to some extent. A number of methods achieve reduced heat input. Inert gas shielded arc welding is usually speci-

fied for sheet or very light plate. High rates of travel can be obtained and the amount of fused metal is held at a minimum. The low heat input along the joint minimizes the structural change in the nearby metal. Atomic-hydrogen arc welding is even faster. It is often used for making corner joints and edge welds in very thin sheets. But metal-arc welding is most widely called for in welding 430 sheet. Metal-arc welding with a coated rod is handier with thicker pieces which need filler rod in addition to parent metal. The amount of heat at the joint is usually substantially less than with gas torch welding, for example, and the weld is more ductile.

As a rule, oxyacetylene or gas torch welding are not recommended for 430 or 430-T. This method involves too much heating of the base metal near the weld. The result is considerable grain growth in the weld zone, plus martensite formation Even annealing does not greatly improve the properties of the oxyacetylene welded joint.

Due to the lower coefficient of expansion of the 17% chromium stainless steels, there is not nearly the warpage problem during welding that is encountered when welding the 18:8 stainless steels. The material's higher thermal conductivity helps diffuse from the weld zones. Even so, in order to keep welded articles true to shape, it is wise to use jigs and clamps and copper chill bars.

When filler metal is required, it is suggested that either a 308 coated electrode or a 308 bare rod be used, depending on method. Types 309, 310 and 347 can also be specified. These chromium-nickel materials provide a tough, ductile weld in place of the comparatively brittle 430 weld metal. This does not alter the effect of the heat on the parent metal adjacent to the weld, of course. Welds made with chromium-nickel stainless filler rods cannot be color blended to 17% chromium stainless sheet by polishing, however. In case such a color match is important, 430 weld metal must be used.

Joints should be at least stressed parts of a weldment. External or internal notches found in corner joints or tee joints with incomplete penetration should be avoided. In general, butt welds, either single or double, with complete penetration are the first choice. Fillet welds are quite satisfactory. Corner welds are all right in some cases but a flange and butt weld is more desirable than a lap or corner weld. Lap welds, either single or double, tend to localize stresses and are, therefore, not as effective.

The technique for welding 430 wire is similar to that used for 302 wire, but the permissible limits for welding conditions are more critcial. As the wire diameter decreases, the necessity for short welding time becomes greater. This localizes resistance heating at contracting wire surfaces, avoids crushing smaller sections. A welding machine with full electronic control and synchronous current application is recommended.

Two resistance processes are used to butt joint 430 wire: flash-butt welding and upset-butt welding. The heat-affected zones near the weld are smaller with the flash-butt process. In making either joint, short welding time and low current are desirable. The amount of heat flowing into the wire should be minimized. The current carrying jaws must be as small as possible, yet large enough to permit adequate flashing or upsetting. This keeps the amount of wire which reaches a temperature high enough for grain growth at a minimum. The upset should be generous enough to insure a clean, sound weld.

Butt joints in 430 wire do not have the same ductility as joints in 18:8 wire. Annealing in a butt-welding machine helps, however. To do this, unclamp the as-welded joint and remove it from the contact jaws. This lets the jaws open to their normal position. Remove the weld flash, then hold the welded part in contact with the jaws. Pass an intermittent current through this portion until it is heated a dull cherry red (about 1450 F) but no higher. After the annealing temperature is reached, allow the wire to air-cool. If joints of dissimilar metals are permitted, a butt weld between 302 wire and 430 wire can be tried. Such a joint displays better ductility in the as-welded condition than a 430 to 430 joint.

Under some conditions folds or crevices in the weld-flash around the wire joint afford a point for corrosive attack. This can be minimized by cleaning and electropolishing to eliminate accumulated weld scale and surface roughness.

All weld seams should be ground or machined smooth, clean, and free of surface discontinuities. This prevents corrosion-sensitive crevices. Of course, a crevice may be part of the joint itself (edge joints, lap joints, etc.) or may occur accidentally when a fusion weld is undercut. To minimize crevice corrosion, joints with unfused notches or other discontinuities should be eliminated.

Brazing and Soldering

Brazing is somewhat marginal with 302 because it involves relatively long periods in the sensitizing temperature range. Either copper brazing or silver brazing may be used with 430, however. Silver brazed joints should not be exposed under water or in moist atmospheres.

Soldering is used for filling or sealing joints in lock seams, spot weld seams, etc. Solder should never be depended upon for mechanical strength. To join 430, roughen the surfaces. Use a stainless steel flux and a solder with a tin content over 50%. Employ a large soldering iron. It is especially important to take all traces of soldering compounds off after soldering, since they will attack the metal. The entire part, particularly the joints, is washed with sodium carbonate solution (1 lb soda to 1 gal of water). Immerse the part completely in the solution if possible, then neutralize. Finally, scrub thoroughly with clean warm water.

Finishing

Type 430 and its modifications are not difficult to buff and polish. In many cases the bright rolled finish of these alloys is satisfactory with only a superficial buffing. Since this particular finish is not available in 302, finishing operations can actually prove more economical. Polished finishes obtained with an abrasive, however, may be a bit more expensive than with 302. This is true if the product has been severely formed. Resultant stretcher strains and "ropiness" require extra grinding. Even so, 430 stainless steels develop a higher color than can be produced by the same amount of work on 302. Fully polished, the surface resembles chromium plate.

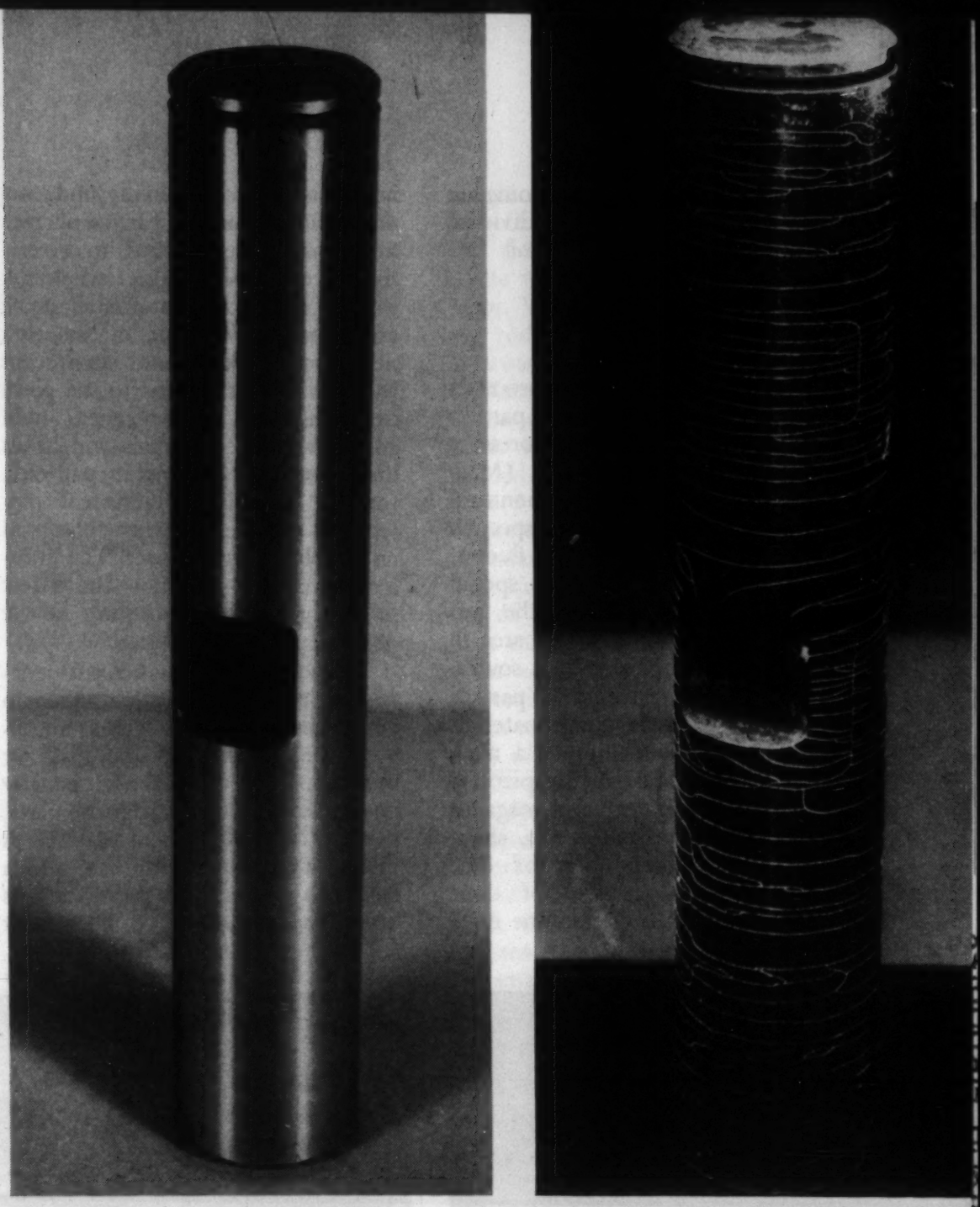
Electro-polishing of 430 stainless has proven practical on a number of kitchen accessories. Results, however, are not equal to the results obtained with 302.

Type 430 F is passivated by immersing in solutions of concentrated nitric acid containing not less than 15% by volume and preferably 20 to 40%. Immersion at 110 to 130 F (not more than 150 F) for 30 to 60 min is recommended.

Black Light Spots Defects in Materials

Nondestructive inspection of metals and non-metals by fluorescent methods depends on ultraviolet energy to make visible flaws that might cause failures.

by **N. E. WALTERS**
Commercial Engineering Dept., Westinghouse Lamp Div.



Truck king pin as it appears under visible light and under black light after processing with special fluorescent solution. The indications mark grinding cracks. Such cracks can be serious sources of fatigue failures.

● BLACK LIGHT inspection methods are used in nearly all types of industry. Precision casting, rough forging, aircraft, automobile, farm machinery, motors, electronic, electrical, steel, chemical, oil, fabrics, pipe, railroad, tool, ordnance, food, metal fabrication, glass, ceramic and mining are some of the industries that use this method. New uses are continually being found for black light, and its future offers possibilities for accelerating inspection procedures with increased accuracy.

Inspection with ultraviolet energy offers many advantages over other inspection means. Among these advantages are flexibility, economy, speed and sensitivity. Furthermore, inspection processes utilizing ultraviolet are nondestructive. Sensitivity is increased because the smaller defects, not ordinarily seen under visible light, are readily picked up when made fluorescent under ultraviolet energy. Any surface—rough or smooth—can be inspected equally well and with equal perceptibility of defects. This method is particularly effective on irregularly shaped and threaded objects, coil springs and bores.

The term "black light" refers to a region of ultraviolet energy which is adjacent to the visible blue region of the electromagnetic spectrum. Black light is composed of long wave ultraviolet which is not injurious to the skin tissues or to the eyes and does not cause eye fatigue when properly used. For maximum inspection effectiveness, the lamp should shine down and away from the operator's eyes.

When a black light energy source is directed upon certain materials, visible light is emitted due to an energy-conversion phenomenon with-

Portable black light fixtures can be used in many industrial inspection applications.

in the material. This phenomenon is known as fluorescence. Individual fluorescent materials will emit different visible colors.

Inspection Methods

There are two accepted processes of nondestructive fluorescent particle inspection. One method is fluorescent magnetic particle inspection (Magnaglo) and the other is nonmagnetic fluorescent penetrant inspection (Zyglo). Both processes use fluorescent material suspended in special oils, and the inspection of the part is carried out in a darkened area in the presence of a black light source.

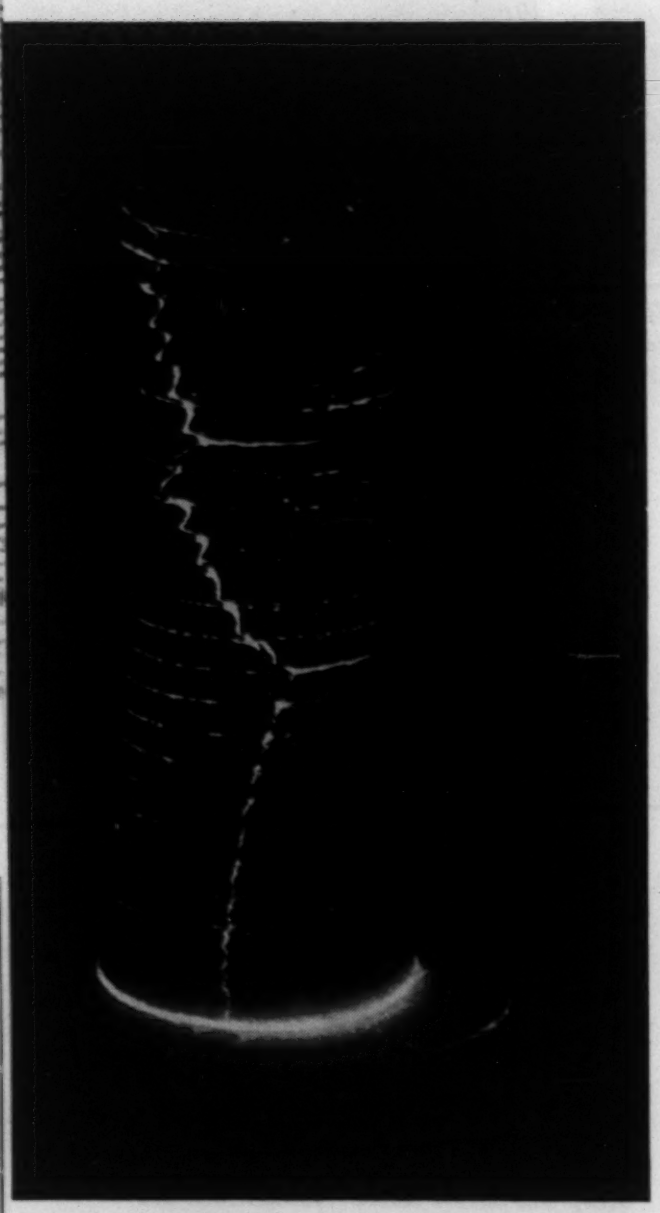
The fluorescent magnetic particle process is used on magnetic materials only. By induction currents, a magnetic field is created in the piece to be inspected. The degree of magnetization depends upon the size, shape and material composition of each piece. Upon interruption of these currents within the part, some magnetic flux will remain around any discontinuities on or near the surface of the material, resulting in a relatively strong local magnetic field. A special fluorescent magnetic paste mixed with a suitable oil solution to form a suspension of fluorescent particles is then applied to the piece being inspected. The magnetic field around the defect attracts and holds the fluorescent magnetic particles, forming a brilliant fluorescent pattern of the defect when observed under a black light source. The fluorescent material will show the defect as a bright color contrasting to the dull purple of the piece.

The nonmagnetic fluorescent penetrant inspection is usually applied to nonmagnetic materials such as aluminum, magnesium, plastics, glass or ceramics. It can be used with equally good results on many magnetic parts, however. The fluorescent material is dissolved in a special oil base which has high penetrating ability and is washable in water. As the fluorescent penetrant solution is applied, it is drawn into any surface defect by capillary action. The excess penetrant is washed away with a water spray, and the inspection piece is allowed to dry before a thin film of developer is applied. The developer draws the oil penetrant to the surface. The part is then inspected in a darkened area under black light.

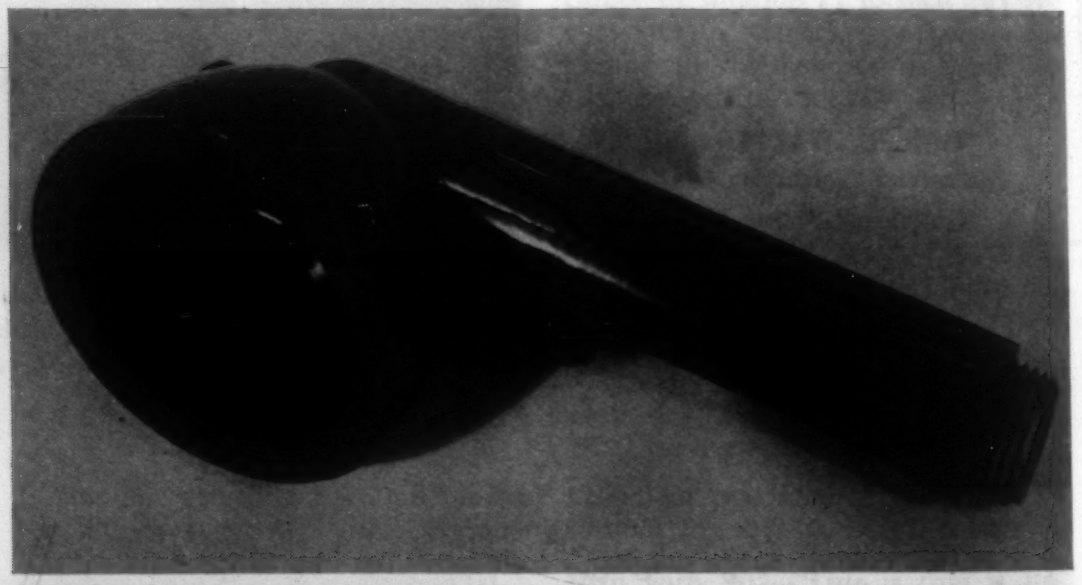
Black Light Sources

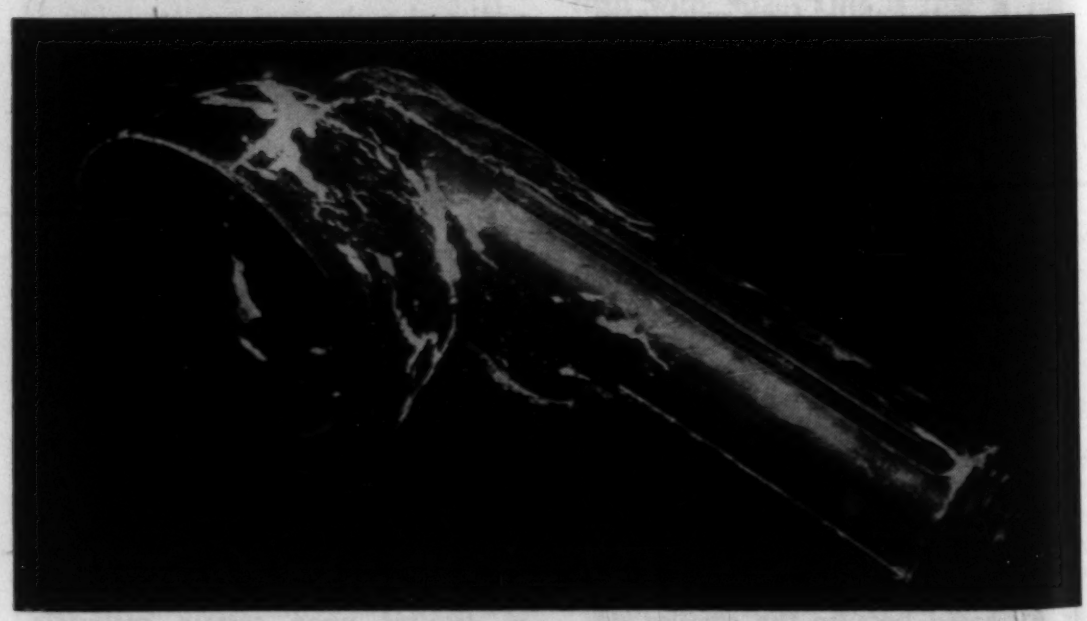
The black light source used for inspection should be of relatively high intensity, efficient, reliable, long-lived and easy to replace in the event of a burn out. The most commonly used sources for black light today are the mercury-vapor lamps. Like all vapor-type lamps, the mercury lamp must have ballasting or transformer equipment to initiate the arc and to limit the current flowing across the arc after the lamp is started.

The 100-watt spot and flood lamps are the most popular for industrial



Fluorescent indication of heat treating cracks in an aircraft bolt under black light.





Molded plastic radio microphone under visible light and under black light after processing with fluorescent penetrant.

inspections. These are of the projector type and have self-contained reflectors which will not tarnish or mar despite the corrosive atmosphere often found in industrial locations. Because the lens is made from clear glass, these lamps must be fitted with a suitable filter to absorb the visible radiations. As for all mercury lamps, the filter should be made from a heat resisting glass. The filter should be round, and, in general, clipped to the rim of the lamp by a suitable ring holder or inserted within a housing designed to prevent leakage of visible rays.

Most of the other mercury vapor lamps also require filters and generally need reflecting equipment to direct the rays onto the work area. One standard lamp requires no filter since the outer bulb is made of red purple glass and acts as the filter. Reflecting equipment is needed with this lamp.

A time interval of several minutes is required for all mercury lamps to warm up and reach full output. An interruption of the power supply or a sudden drop in voltage of more than 15% will extinguish the arc of these lamps. Before the lamp will relight, it must cool sufficiently to reduce the mercury vapor pressure to a point where the arc will restrike at the available voltage. If the lamp is to be used for frequent but intermittent inspections, it should be burned continually.

Black light is also available from tubular fluorescent type lamps. These lamps are identical to general lighting fluorescent lamps, with the exception that they contain a special phosphor, which radiates large quantities of black light ultraviolet energy. These lamps are available in several sizes, but the 15-, 20-, 30- and 40-watt are the most applicable where large pieces are being inspected, and a general flood of black light is needed throughout the inspection area.

Although fluorescent type black light lamps emit only a small quantity of visible light, it is recommended that a plate or tubular glass filter be used to limit the amount of visible light when using these lamps for inspection purposes. Certain types of dark blue or violet colored glass can be used as an ultraviolet filter with these lamps. Due to variations in color, color density and thickness, these filters must be chosen with discrimination so as to obtain the glass with the best characteristics. For best results and maximum perceptibility, it is recommended that high quality filters of specific transmission characteristics be used. Such filter glass is available from several leading glass manufacturers. Special fluorescent fixtures with attached filter glasses are available, but these lamps can be operated in the same fixtures and on the same auxiliaries as the corresponding sizes of regular fluorescent lamps.

Applications

Black light inspection is used in many industries. Plastic molders check their products for distortion cracks, molding defects, gas cracks and shrinkage cracks. Many major railroads periodically check their rollstock, especially axles, wheels, gears and diesel crankshafts for fatigue, thermal and corrosion cracks. These black light inspection methods incorporate more sensitive techniques, therefore, to allow defects to be located while still small. In many cases, steps can then be taken to repair the defect before it passes the stage of preventive maintenance, thus giving a higher rate of salvage.

Because most petroleum products fluoresce a bluish-white, black light sources can be used to detect traces of oil and grease on machinery. This method is often used to find petroleum products on parts that should be free of such contamination. Light sources have also been used to check freon refrigeration system for leaks. A combination of oil and freon fluoresces when a leak in the cooling system is brought under black light.

Aircraft manufacturers must be sure every part of their product is in perfect condition. Inspections are made on castings, propeller blades, machined parts and sub assemblies. The oxygen equipment is checked for traces of oil which would cause contamination of the entire system. Fuel lines are checked for leaks by flowing a fluorescent solution under pressure through the pipes. Black light is passed over the entire system and leaks can be observed because of the sharp contrast of colors.

Large truck and bus fleet operators are now using black light inspection methods when overhauling their motor carriers. Complete inspection of cylinder blocks, connecting rods, cylinders, axles and transmissions prevents road failure and possible future damage to vehicles and injury to passengers. Automobile manufacturers also use black light to inspect rough castings and forgings. Such inspection, before machining, culls out the defective parts and avoids costly losses in productive time and labor. Vital linkages such as connecting rods, crank shafts, steering components and axles must be perfect.

Manufacturers of piping, steel containers and boiler equipment use black light to inspect for leaks in welded areas. With the tendency toward higher temperature and higher pressure boilers, special care must be taken that all welds and seams are secure in order to minimize failure of piping and boiler tubes.

A majority of part failures result from small insignificant defects. A discontinuity crossing a field of stress tends to concentrate the stress at the ends of the crack. At this point the effective stress is many times greater than the average. If a defective part continually takes loading, shock and vibration, rapid failures can be expected. Inspection methods with black light help eliminate potential failures because they easily pick up the smallest defect.

Inspection Equipment

There are various types of fixtures and equipment available for black light lamps. Portable units are desirable where the volume of inspection is low or the equipment to be inspected is large, bulky or heavy. These permit maximum flexibility at minimum cost. Small portable fluorescent lamp units are available in 4-, 6- and 15-watt sizes, but they may lack the ultraviolet output required for critical inspection work. For critical inspections, portable fixtures containing either 100-watt mercury flood or spot lamps are used. These are generally recommended where high intensities of directed ultraviolet light are required. For high volume inspection, there are several types of unitized equipment designed to provide rapid inspection operations.

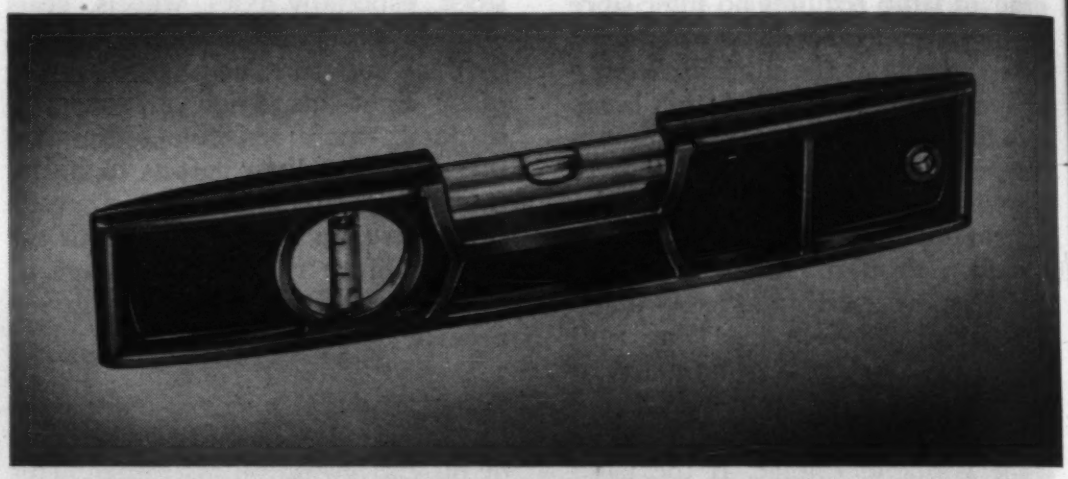
If greater degrees of fluorescence are required, more black light units can be used. Experimentation has shown that many fluorescent materials have an almost unlimited saturation point. This means the more ultraviolet energy that is applied, the greater the contrast will be between fluorescent and nonfluorescent objects. Maximum contrast provides easier and faster inspections.

All photographs courtesy of Magnaflux Corp.

Delicate Parts Embedded in Compression Molded, Clear Plastics

Recently developed methods open new possibilities for embedding fragile devices, instruments, novelties and other articles in clear acrylics. Protection against breakage, and more attractive display is obtained.

by TODD HARRIS, Creative Plastics Corp.



Embedding levels such as these in methyl methacrylate plastics suggests other applications in instruments and liquid containers.

● FOR MANY PURPOSES, it is desired to embed articles of various kinds in clear plastics, and especially in the acrylics, which have the best optical properties and the best resistance to yellowing. Although embedding presents no great difficulty in most cases, the problem becomes more difficult when the inserts are fragile and they must be positioned with greater accuracy. It has been customary to use casting processes when embedding fragile pieces, so that the piece will not be broken nor distorted by the flow of hot viscous resin into or through the mold cavity in molding processes.

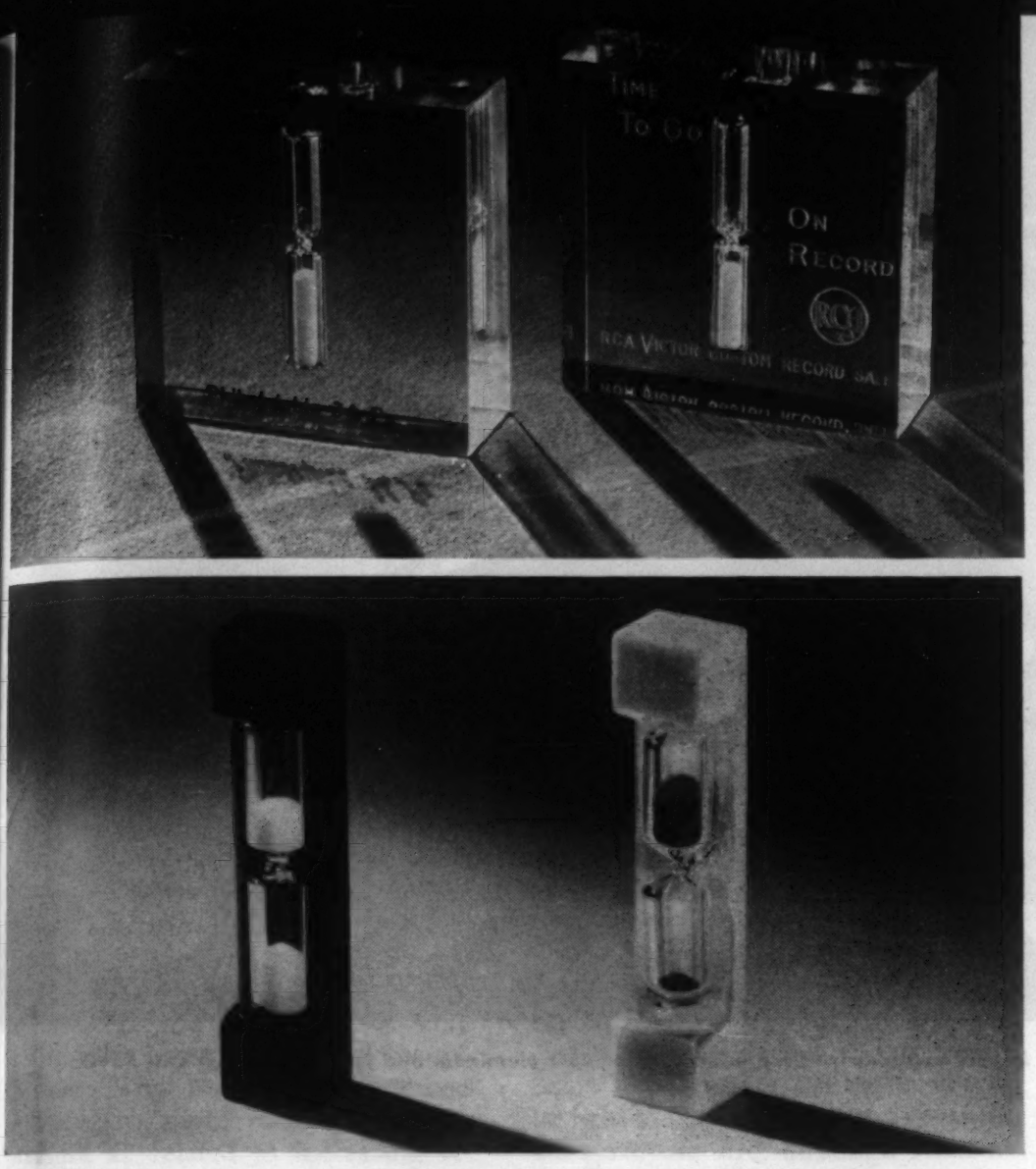
Embedding in the casting resins, frequently phenolics, is a slow process, and the materials usually lose strength when enough accelerator and catalyst are added to speed polymerization so that reasonable production can be obtained. Injection molding with the acrylics is sometimes a difficult operation when the inserts are of a fragile nature, and inserts of unusual materials, such as glass or feathers, are difficult to anchor so that they will not be swept out of position by the viscous acrylic resin entering the mold cavity.

Processes worked out by Creative Plastics Corp. have made possible the molding of pieces of methyl methacrylate with embedded articles of heterogeneous composition. Such a miscellany as glass level vials, fishhooks and feathers, pretzels, fern fronds, watch movements, tissue paper, swatches of fabric, and face powder have been successfully embedded in acrylic resins by compression molding.

Almost anything that is dry can be embedded by this compression molding technique. It is not necessary that the embedded articles be completely free of water, but only that there be no surface moisture or easily releasable water vapor that can be formed during the molding process. Similarly, no greasy articles can be embedded, nor can very fluffy substances be invested in the plastics material without distortion, though feathers in fishing lures have been so used. Readily combustible articles that will take five at the molding temperature are also ruled out.

Molding Process

In the process, it is necessary to reduce the flow of the viscous acrylic in the mold cavity to a minimum to avoid displacement or distortion of



A variety of displays and novelties are being made as clear embedments.

the embedded article. This is done by (1) using a fine-particle molding powder, and (2) spreading a measured layer of the powder in the mold cavity. Positive molds are used, and a minimum of relief is provided in the mold. The molding powder is measured into the cavity, spread out evenly, then tamped down, and the article to be embedded is inserted. After careful positioning of the insert, another measured layer of powder is added and tamped down. The mold is then closed, heated to about 300 to 350 F to fuse the resin. The pressure used is generally about 500 psi, and the temperature will depend upon the size of the piece. Molds are loaded by hand. Cycles are usually short, some as low as 3 min.

After molding, it is sometimes necessary to stress anneal the piece to secure dimensional stability. This is done regularly when the inserts must be positioned with special accuracy and must maintain that accuracy, as in liquid-filled glass tubes for leveling instruments.

A problem that arises in embedding the wide variety of articles now being used as inserts is that of differential heating of the several materials used in some inserts. Examples of this are found in the embedding of miniature radio tubes and watch parts. Copper parts tend to conduct heat from the contacting fused resin faster than nonmetallic or other metallic portions of the insert. Usually the problem can be solved by molding the piece at a slightly higher temperature than would be used otherwise. The amount of increase is determined from experience. But care must be used to avoid overheating and blistering around the nonmetallic portions.

Applications

An important present field for clear embedding is in the production of shatterproof levels and similar shatterproof containers for liquids. The shatterproof levels are made by embedding a glass vial containing a liquid and a bubble, into clear methyl methacrylate, and then machining off the bearing surface until the bubble indicates exact horizontality. The moldings are stress annealed before machining. The liquid used depends upon the purpose to which the leveling tube is to be put. A mixture of water and alcohol is satisfactory for most levels, but for embedded vials one or more hydrocarbon liquids are used to withstand the high molding temperatures and yet flow at —40 F.

The torpedo levels are made with a high-impact polystyrene frame, in which the a crylic-embedded glass leveling vial is mounted. The frame is trued by machining the bearing surface while the tool is held in the proper indicating position.

In electrical or electronic units, clear embedding is sometimes used as a means of taking electrical leads through the sheathing. Demonstration units in which the flow of a liquid can be shown, or the corrosiveness of a liquid can be displayed, are now being produced. One of these shows the results of action of a liquid upon steel; by sealing the steel test piece in clear plastic, the result of the corrosive action is shown as it was at the end of the test, without additional atmospheric corrosion.

Other fields in which clear embedding is well established are the display and novelty lines, and in jewelry specialties. Advertising items in which keys, watch movements, labels, bits of fabric, medallions, 3-min. glass timers for use in timing phone calls, and similar objects embedded in clear acrylic are popular. Some of the more unusual of these novelties that have been made have contained small pretzels, mounds of face powder, and coffee beans as the embedded articles. The pieces are made as paper weights, letter openers, coasters, key tags, plaques in many shapes, etc. Production of such a range of embedments is a challenge to the ingenuity of the molder.

A line of novelty jewelry for men that has won popularity includes embedments of fish hooks complete with brightly colored flies, made in quantity in multiple cavity molds.

Future Uses

Looking ahead, in experimental stages now are larger levels up to 24 in.; the use of phosphorescent pigment to illuminate the products; and embedment of glass electronic tubes and open end measuring tubes. This opens new possibilities to manufacturers of equipment where glass assemblies are used. Expensive, difficult-to-read glass indicating equipment, hidden behind costly protective metal frames, can be replaced with clear, magnifying acrylic embedments which bring with them shatter-proof protection against blows from the outside and bursting when under pressure from inside. Expensive precision glass can be replaced with extruded or molded glass in its acrylic molded embedment.

Group of forward, reverse and double impact extruded parts produced from 2SO aluminum and the alloys 61SO and 75SO.

High Strength Aluminum Impact Extrusions

- ***Now Complete with Forgings in Strength***
- ***Have Good Finish***
- ***Meet Close Tolerances***

by M. P. MEINEL, Production Design Engineer, Lockheed Aircraft Corp.

● RECENT IMPROVEMENTS in the techniques of impact extruding have shown that high strength aluminum alloys can be worked by this method into a variety of shapes. Accordingly, impact extrusions have become competitive with forgings on a strength basis and have the added adventages of superior surface smoothness, close dimensional tolerance and the elimination of the draft angle necessary for forgings. Experience is now being accumulated on production applications of parts made of 61S, 14S and 75S alloys, with 24S being avoided if possible because of the difficulties involved in extruding this alloy.

The major difference noticed when working the high strength alloys rather than commercial aluminum is the higher extruding pressure required, which increases in nearly direct relationship to the tensile strength if extruding is done at room temperature. More difficulty is experienced also with shear cracks and surface tears as a result of unequal metal flow and the greater tendency of the high strength material to follow natural flow lines.

Impact extrusions are classified as forward and reverse extrusions, depending on the direction in which the metal flows. In a forward extrusion the metal moves in the same direction as the punch travel, as contrasted with metal moving in a direction opposite to the punch travel for reverse extrusions. Occasionally it is necessary to produce double extrusions, parts with metal movement in both directions. These can be made

in either one or two operations, depending on part shape and variations in the cross sectional area.

Design Factors

The most familiar shape for an impact extrusion is the round collapsible container found in every household, an example of the long-standing rule that impact extrusion should have a balanced symmetrical cross section. Recent development work has shown that the cross-section can vary considerably in symmetry and wall thickness. Parts open on one or two sides can be produced with increased die cost as the only penalty.

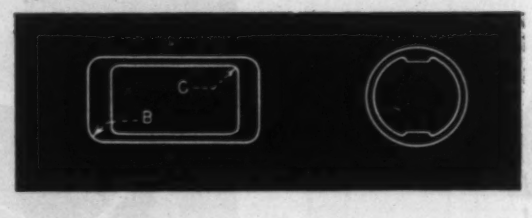
The most important criteria in producing impact extrusions is the reduction in area which occurs between the cross sectional area of the blank and the smallest cross sectional area of the extruded part, for this is the major factor controlling the pressure required for extrusion. The accompanying curves indicate the rapid increase in press pressure as related to increasing reduction in area, the pressures reaching the prohibitive stage with reductions over 95%. Although all of the alloys mentioned are usually extruded at room temperature, a reduction in press pressure can be achieved by extruding at elevated temperatures. Closely related to and a factor in establishing reduction in area is part wall thickness, which has the limitations given in the table. Walls do not need to be constant around the part but must be constant from end to end when the reverse extrusion technique is used. Heavy areas should balance each other, however, to prevent side loads being exerted on the punch.

Using the values given in the curves, the maximum projected area can be determined for any given press capacity by dividing the latter by the necessary tons per square inch. In no case should the thickness of part flange or bottom be less than the wall thickness. The recommended minimum thickness is 0.125 in. for 14S and 75S aluminum alloy. The internal bottom radius R gives best results when held to a range of 0.03 R min to 0.19 R max. A thick bottom is a definite aid in getting the extrusion to remain in the die where it can readily be ejected.

Overall length of the part is dependent on the tools and the press being used. On reverse extrusions, length is related to the slenderness ratio of the punch and should not exceed four times the punch diameter for 75S blanks or six times for 61S blanks. If these values are exceeded the punch begins to wander during extrusion, causing excessive variation in wall thickness. On forward extrusions, parts can be made to almost any desired length provided there is ample clear space in the base of the press into which the extrusion can flow, and the stroke is long enough to allow the part to be removed from the die. Parts with a length more than 100 times the diameter have been made on a production basis.

When the inside dimension of an impact extrusion is 3 in. or greater, it is advisable to introduce a taper in the bottom of the part to facilitate the flow of metal and reduce the tendency of the punch to wander. A flat central area with a recommended taper is given in an accompanying sketch.

The external radius B (see sketch below) on rectangular parts should be held to 0.22 in. or greater to secure adequate die life, although from an extrusion standpoint a 1/32-in. radius



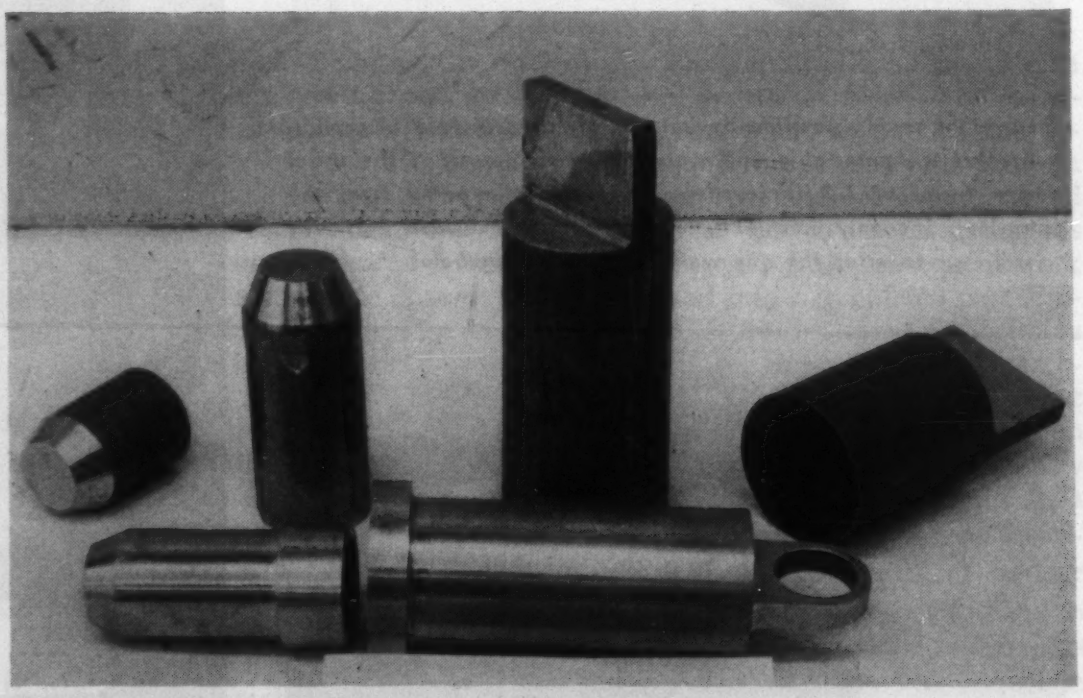
Wall thicknesses need not be constant in reverse extrusion but heavy areas should be balanced to prevent side loading of the punch.

can be developed on the part. A practical minimum for radius C is 1/32-in. Tolerances on impact extrusions are comparable to tolerances for machined parts. Minimum values are as follows:

Width of part: ±0.010 in.
Wall thickness, all forward extrusions: ±0.005 in.
Wall thickness of reverse extrusions having punch slenderness ratio of 3 or more: ±0.015 in.
Reverse extrusions having punch slenderness ratio of less than 3: ±0.005 in.
Length of part extruded to exact final length: ±0.12 in.
Bottom thickness as extruded: ±0.010 in.

The surface finish of impact extrusions ranges from 40 to 250 micro in., depending on variables existing during extrusion. Poor surface condition of the blank will result in parts exhibiting scores, surface checks and gall marks. Excessive amounts of lubricant, or the use of lubricants containing pigments or fillers, will have a detrimental effect on surface finish of the part. Sharp edges on the back side of the punch land or excessive relief on the punch contribute to surface galling as the punch withdraws from the part.

Blank size is controlled to correspond in volume to the extruded part. Since the extrusion does not come out with uniform length at all points, it is necessary to extrude the rough impact 1/4 to 1/2 in. longer than the de-



This telescoping cylinder assembly uses mating surfaces and tolerances as produced by impact extrusion. Clearances range from 0.005 to 0.020 in. The outsides of the pieces are machined to produce the shoulders at the open ends. Most of this machining could have been eliminated if the production rate had been great enough to justify additional tooling.

Minimum Dimensions for Aluminum Alloys

Alloy	Min Wall Thick, In.	Min Bottom Thick, In.
2S & 3S	0.008	0.010
61S	0.040	0.080
14S & 75S	0.045	0.125

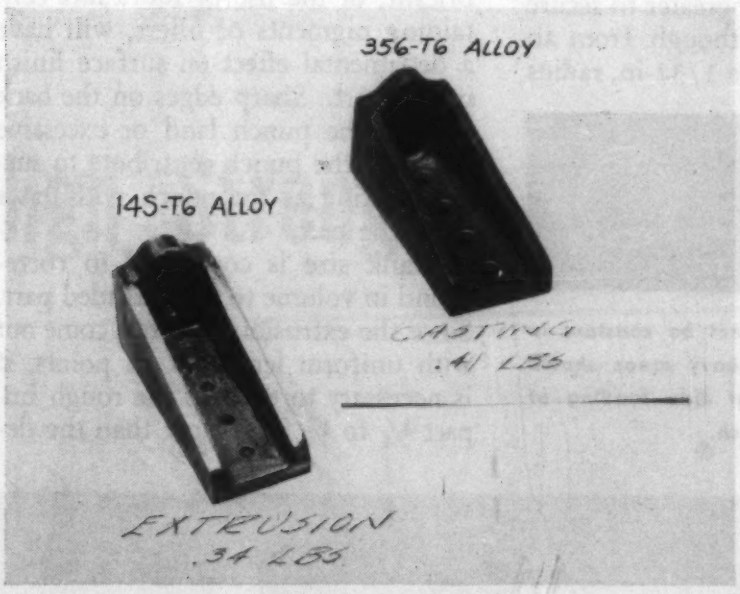
sired length. Although the blank need not closely fit the die cavity, it should be of such shape as to make it impossible to place off center and thus lose concentricity in the finished part. An undersize blank reduces the shock loading on the tools and assumes a plastic state under the pressure of the punch before the peak extruding load is reached. Less difficulty with tool breakage can be expected if undersize blanks are used.

Processing Characteristics

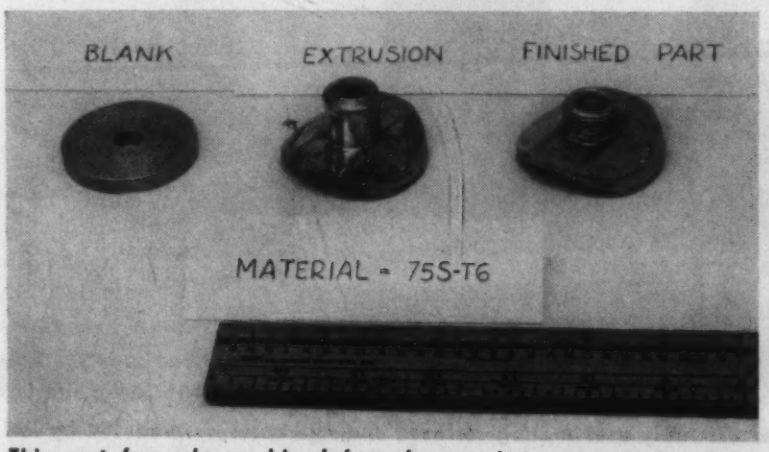
One of the most troublesome problems with impact extrusions is the adherence of small amounts of aluminum alloy to the land and radius of the punch, resulting in galling and scoring of the part surface, and becoming worse as the temperature of the blanks is increased. Several factors affect the amount of pickup, these being the type of steel used in the tools, the lubricant and surface treatment of the blank. Bonderite treatment of the blank not only reduces pickup but also improves the surface finish of the part. The ideal lubricant varies somewhat with the conditions of extrusion, tallows and waxes being good for parts of short or medium length made at room temperature, while long parts which build up considerable temperature during extrusion or parts made at elevated temperature require lubricants with better heat resistance. A few satisfactory lubricants are:

1. Pure lanolin (degras)
2. Houghton's A & M Drawing Oil #4
3. Houghton's QR-9 Oil
4. Johnson's Wax III
5. A.C. Withrow 91-A Forging Compound.

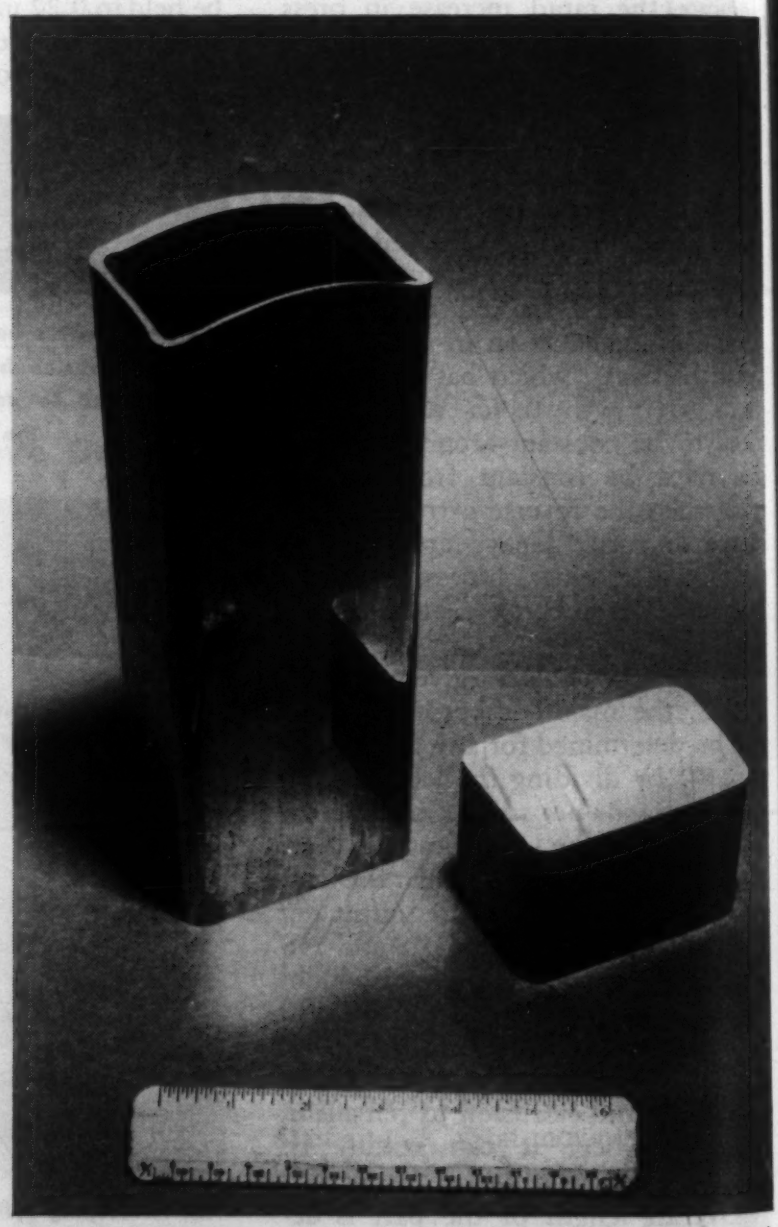
Even the best tools eventually crack or break under the high stresses developed during extrusion. To attain maximum die life, the die ring should be shrunk into an outer ring with sufficient interference to develop a high compressive stress in the die ring. An efficient die design for a reverse impact extrusion utilizes a cavity cut completely through the die, which is then blocked off with a bottom block made to a close sliding fit with the cavity. No draft is used in the die cavity, causing the part to stick in the die then to be ejected by a knockout pin operating against the



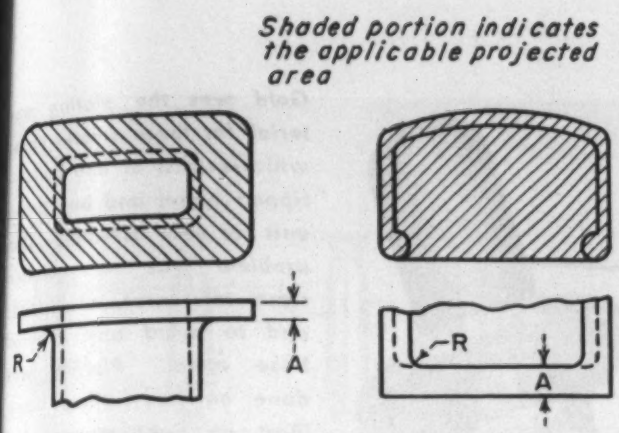
The weight saving possible by impact extruding instead of casting a bracket is appreciable and would be even greater if the usual design factor of 1.3 for castings had been eliminated from the extrusion. The only machining required on the extruded part was tapering the side walls and drilling the holes.



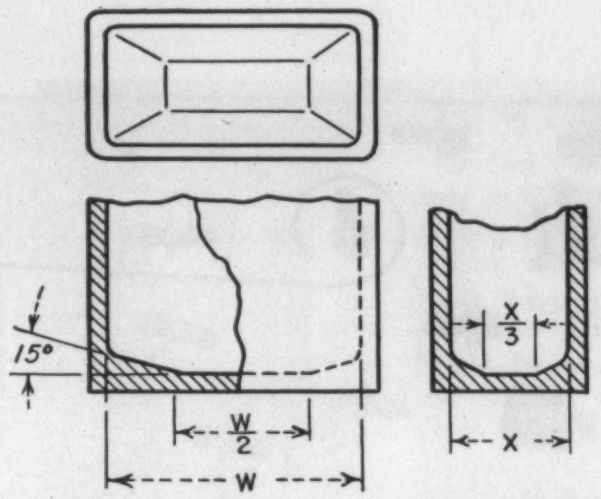
This part formerly machined from bar stock is now produced by impact extrusion. In addition to securing greater yield from the same quantity of stock, rate of production was increased 25 times.



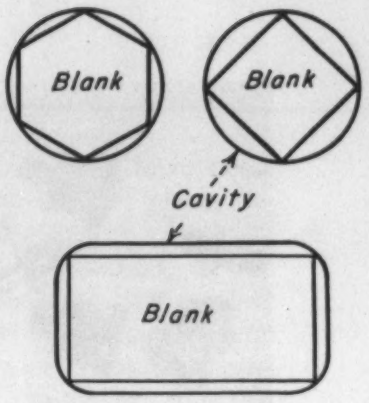
The largest impact extrusion which has been made at Lockheed is 2½ in. by 3¾ in. and 10¼ in. long. The alloy was 14S bar stock.



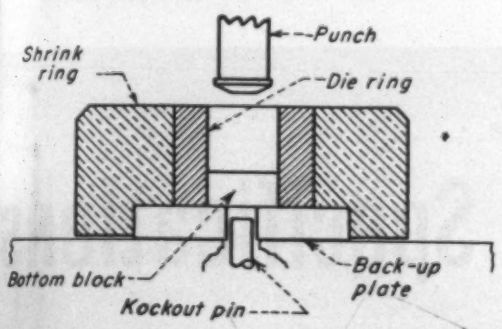
The maximum projected area, shaded portion, can be determined for any press capacity by using the values given in accompanying curves. The flange or bottom (A) should never be less than the wall thickness. Best results are obtained when the internal bottom radius is held within the range 0.03 R to 0.19 R.



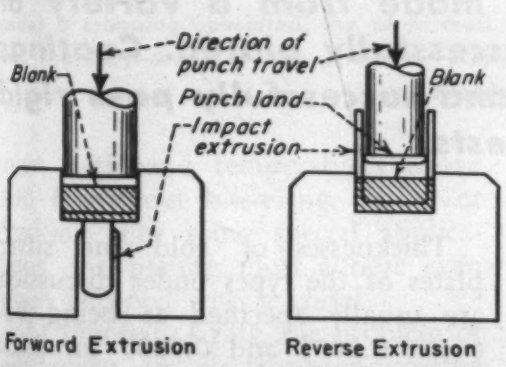
For large extrusions, a bottom taper should be used to facilitate metal flow and reduce the tendency of the punch to wander. Recommended tapers are given.



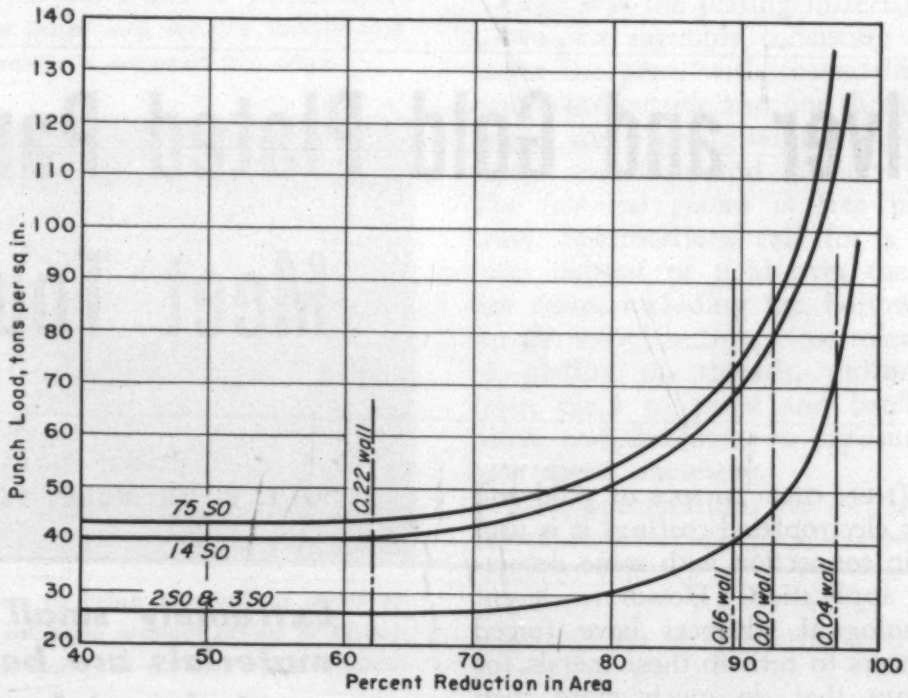
Although the blank need not fit the die cavity closely, it should be of such a shape that it cannot be placed off center. The corners of the blank should touch the walls of the die cavity to center the blank.



An efficient die design for a reverse impact extrusion utilizes a cavity cut completely through the die, which is blocked with a bottom block made to a close sliding fit with the cavity.



Diagrammatic sketch of the direction of metal flow in forward and reverse extrusion.

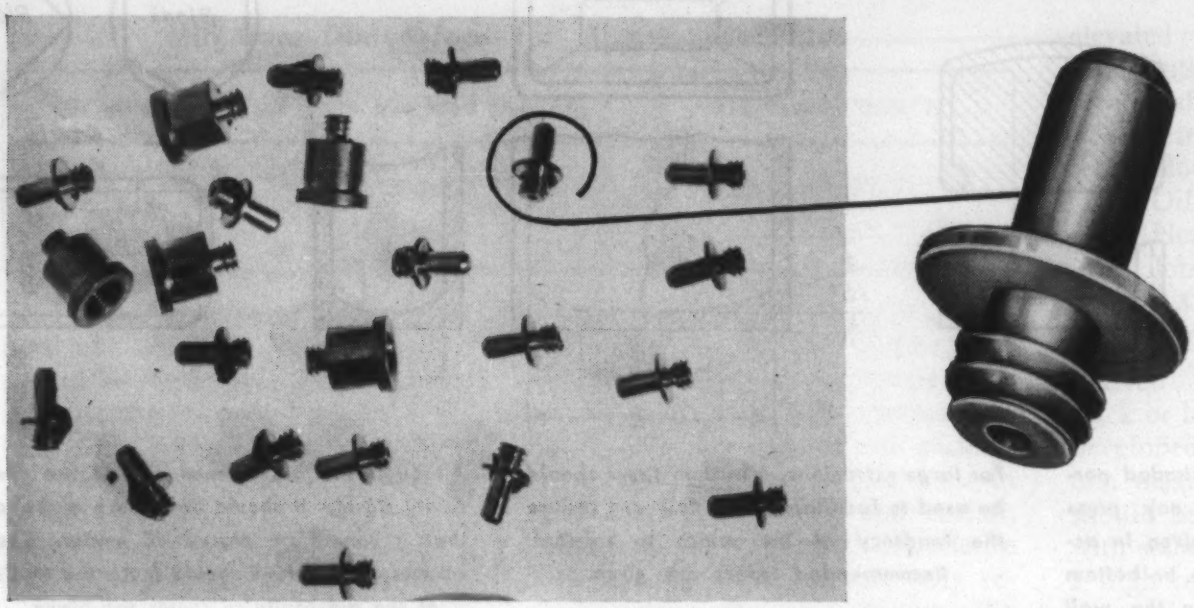


Pressures increase rapidly with increased reduction of area of the extrusion.

bottom block. The die set for these tools should be extra heavy with sturdy leader pins to maintain alignment.

Although it is feasible to do impact extruding at room or elevated temperatures, there are several advantages of extruding at room temperature. Most parts generate heat during extrusion due to absorbed energy and the temperature may rise 300 to 400 F. When this temperature rise is added to the temperature of a heated blank, the aluminum alloy softens and becomes sticky and adheres to the punch or die, thus creating scoring and gall marks on the finished part. Lubrication is considerably more efficient on blanks at room temperature, giving better surface conditions and reducing die pickup. Heated blanks usually require a complete change in lubricant in order to stand the change in temperature. On reverse extrusions, parts extruded at elevated temperature stick on the punch unless the punch is constantly cooled, although with forward extrusions the part tends to stick to the punch until the latter develops a temperature of 200 F or higher. Parts of 14S and 75S may require pre-heating to the range of 250 to 300 F in order to secure normal extrusion characteristics if the required reduction in area is small.

The observance of the principles and limitations discussed make it possible to design for impact extrusions in far more applications than appears feasible on the surface. With a little ingenuity on the part of the designer, and the necessary cooperation from the tool engineers, parts of all types come out as impact extrusions requiring very little subsequent work to convert into a completed part. Production quantities usually determine how far the impact extrusion technique can be carried economically, but with large quantity, several extrusion operations can eliminate practically all machining. Where weight is a factor, impact extrusions are invariably lighter, have excellent surface finish and strength characteristics akin to forging. Raw material savings often run as high as 85%, and there is a production advantage in the fact that a family of parts can be fabricated on the one die merely by changing shape and size of blank.



Gold was the plating material for these small parts which consist of one hollow-tipped barrel and one prong unit for each assembly. One problem was to maintain close tolerances on threads and to avoid any exposed base metal. Plating was done on free-cutting brass. (Part on right magnified 5 times.)

Silver and Gold Plated Parts Meet Tough Specifications

by **T. C. DU MOND, Editor, Materials & Methods**

Extremely small parts made from a variety of materials are being successfully plated. Coatings meet close tolerances and successfully pass rigid tests.

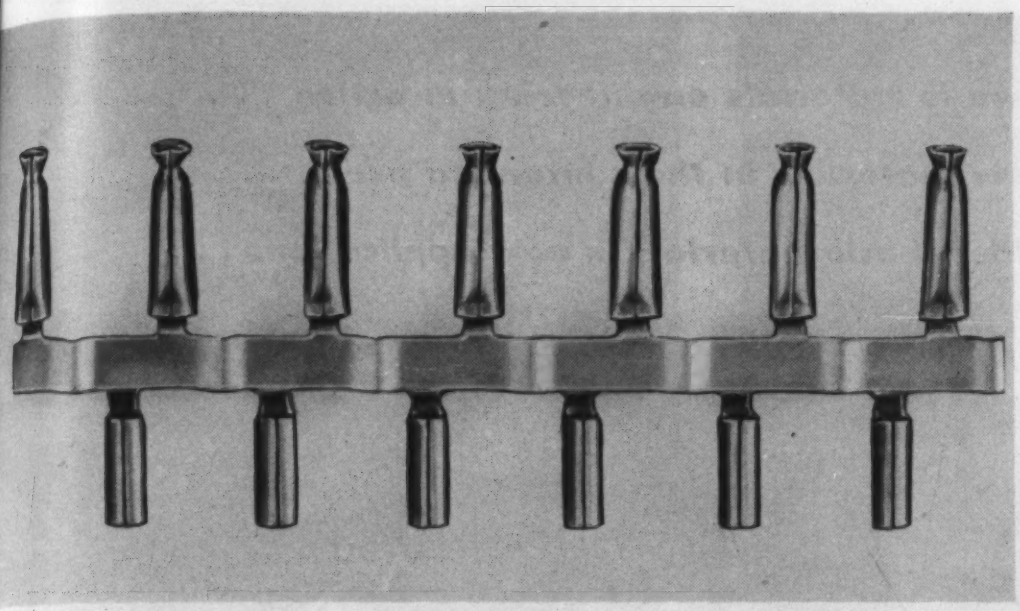
● WHEN ONE THINKS of gold and silver electroplated coatings it is usually in connection with some decorative application. However, recent technological advances have forced engineers to turn to these metals for coatings that do much more than look pretty. In fact, gold and silver are now being plated to highly precise specifications that defy the usual practices of shops which have specialized in the precious metals. One of the few plating organizations in the country that has overcome the problems of specification plating of gold and silver is Donham Craft, Inc., Thomaston, Conn. The problems have been complicated by the fact that most of the parts being plated are extremely small.

For many military and electronic applications silver is specified as the plating material because of its excellent electrical conductivity, its resistance to corrosion, and its lubricating and anti-galling properties. Gold is chosen primarily for its corrosion resistance, but it also is a fair conductor of electricity.

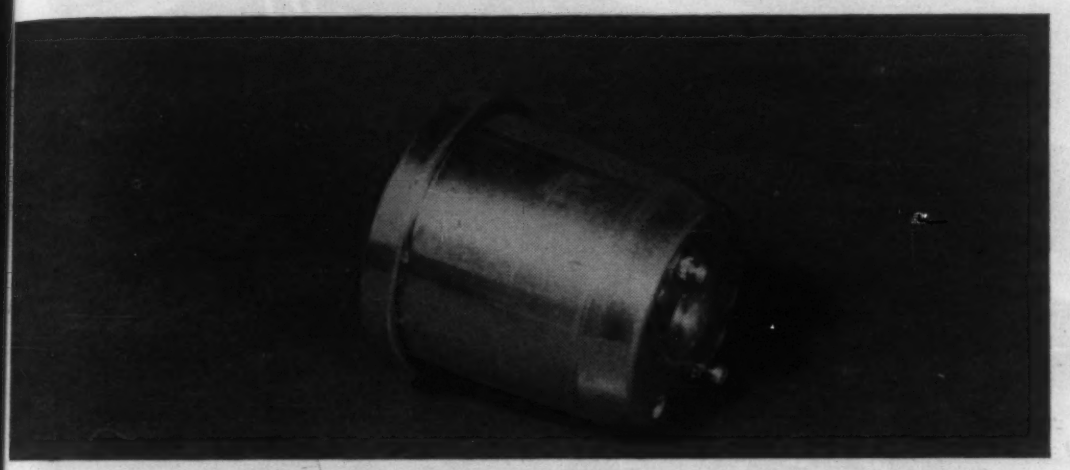
For military and electronic applications, the gold and silver plates must be deposited on a rather wide variety of base metals, including some that are extremely difficult to plate to the required specifications. Among the materials already encountered are: beryllium copper, tellurium bronze, telnic bronze, leaded brasses and carbon and alloy steels, including the highly refractory 25-14 stainless steel. Some aluminum and zinc-base die castings are also plated.

Because many of the parts treated are components of assemblies that must remain in perfect working order under adverse conditions for long periods of time, most of the specifications are extremely rigid, not only as far as thicknesses are concerned, but also as to adhesion. Most of the applications involve the passage of electricity, many times with low voltage current; thus, conductivity must be high and continuous.

Thicknesses of gold and silver plates of the types under discussion are usually specified as being between 0.0002 and 0.0007 in. thick and of uniform thickness over all surfaces of the parts. At times even closer limits are imposed. The specifications become even more stringent when it comes to adhesion of the plated surfaces. Here are some of the tests that plated parts are required to pass: Bend tests, in which the base metal is bent to the point of cracking, where lifting of the plate would reject the parts; adhesion tests on electrical connections where wires soldered to plated surfaces require that the joint be pulled to a rupture with only the solder rupturing without pulling loose the plated coating; and on some parts where high service heat is anticipated, the plating



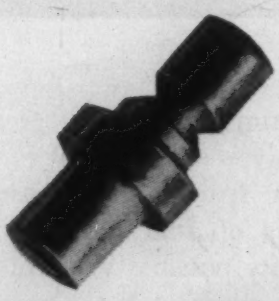
Beryllium-copper was the base metal upon which silver was plated to produce these electrical connectors, which had to be uniformly plated inside and out and survive such severe tests as the bend test for adhesion. Illustration is enlarged 2½ times.



Adhesion demands of this part are severe. In addition to being required to stand up under a crimping operation, the plate must withstand soldering without lifting or blistering. The deep-drawn steel cup is silver plated and production is at the rate of an 0.0005-in. deposit in 5 min.

must withstand temperatures above 500 F without blistering, lifting or cracking. For some special applications, the plating must adhere even when chipped with a chisel.

At Donham Craft, the problem of producing an electroplated coating that would meet the rigid military specifications boiled down to finding a method that would make certain that absolutely clean surfaces were obtained on the base metals. Beryllium coppers and refractory materials often form invisible oxide coatings with extreme speed, thus making plating difficult. Therefore, extreme care is taken in cleaning, not only to remove the normal scales resulting from heat treatment and fabrications but the insoluble compounds that form.



An example of difficult specification plating is this electrical connector which must pass rigid thickness and adhesion tests. The illustration shows the part enlarged about 5 times.

Most of the parts handled at Donham Craft are plated by the barrel method, partially because most of the parts are too small to be racked but also because most of the parts must be completely plated even to the extent that no areas which would be in contact with plating racks could be tolerated. Experience has shown the most efficient methods of loading the barrels and maintaining efficiency of the plating baths so that plate thicknesses can be predicted with remarkable accuracy.

Types of Parts

Several interesting jobs have been done in the Donham Craft plant, including the following:

Tiny electrical connectors, about ⅝-in. long, are made of heat treated beryllium copper and then silver plated. In use, a wire is soldered into one end of the connector and the other end of the connector is crimped over a second wire. Specifications called for a uniform silver deposit over all interior and exterior surfaces of both the hole end and the crimping end. All plated surfaces have to pass a bend test. In addition, the specification called for the same plating results from batch to batch.

Gold was the plating material for a two-part assembly consisting of a barrel-like piece with coarse threading on the outside and fine threading inside, and a prong with a tiny connector wire hole and threaded end. The material plated is free-cutting brass. Specifications call for a uniform deposit of gold over the entire piece, including the hollow tip for the barrel section, close tolerance of plating on threads, uniformity from piece to piece and batch to batch, and absolutely no exposure of base metal anywhere.

Navy specifications are met in silver plating tiny electrical connectors made of free-cutting brass. The specifications call for extremely close tolerances on the thickness and uniformity of plating. The silver plate on the inside diameter of the connector must withstand a severe pull-out adhesion test, using fine wire soldered into the hole.

In other types of work being done, highly refractory stainless steel bolts and studs are plated with silver to prevent the thread from becoming galled and sticking in high temperature applications. In this application both thickness and uniformity of plate are essential, for a tiny spot of exposed base metal could eventually cause the threads to seize and prevent, or at least make difficult, disassembly of the products on which they are used.

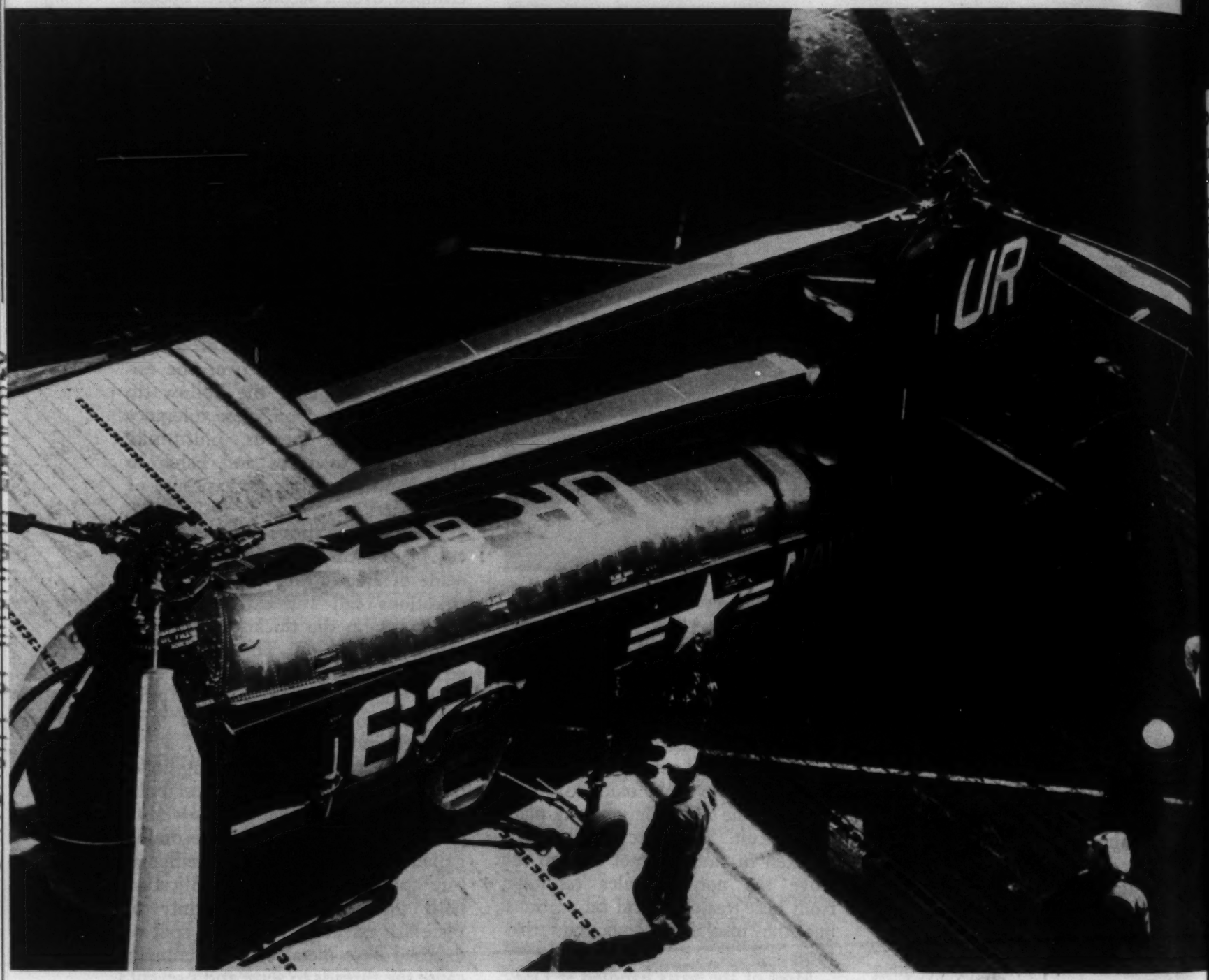
The examples cited are typical of the type of work being done by Donham Craft. The work being done is not too difficult to permit mass production of the parts, but high output is achieved only because experience in specification plating of gold and silver can be drawn upon to circumvent difficulties which might otherwise hamper operations.

Materials at Work

Here is materials engineering in action . . .

New materials in their intended uses . . .

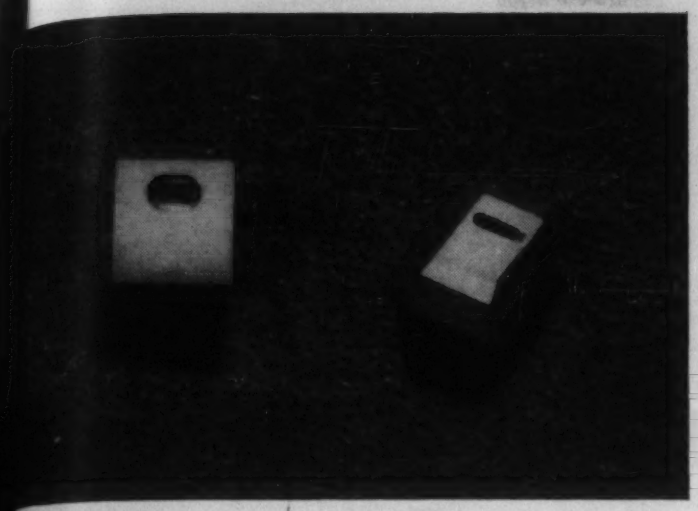
Older, basic materials in new applications . . .



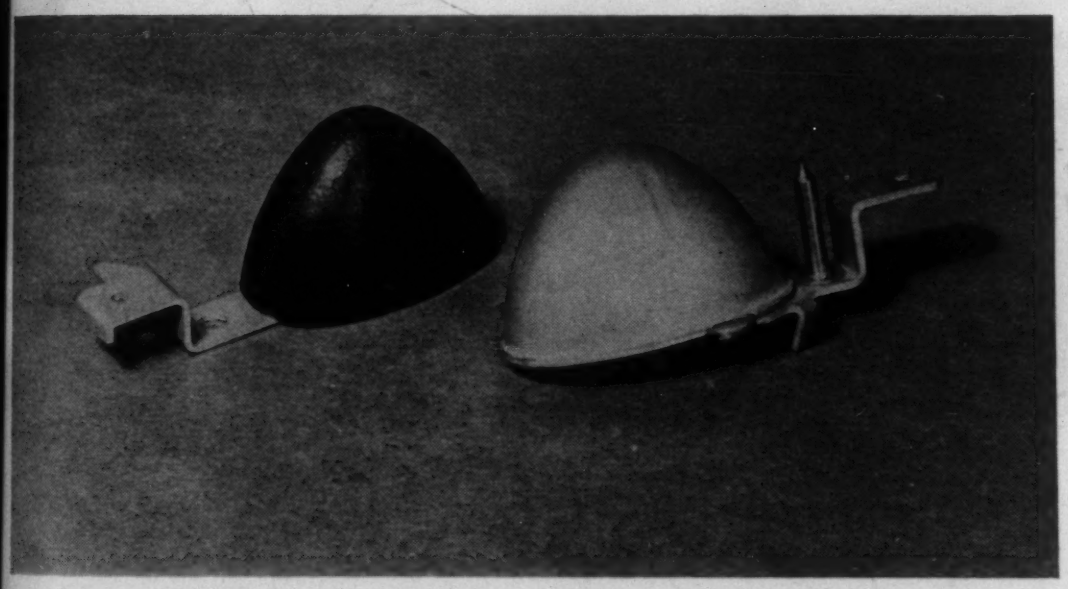
COMPRESSION-FORMED TUBE BLADES Maximum strength and minimum weight for the rotor blades of the Piasecki 44-place XH-16 Helicopter will be achieved through use of compression-formed spar tubes processed by Tube Reducing Corp. Spar tubes form the backbone of the rotor blades and must carry the full load of the strain placed on the helicopter rotor blades. Extruded tubes are processed into spar tubes by the Rockrite compression forming method. When the finished spar tubes are shipped to the Piasecki plant, a milled aluminum skin is placed over the blade's honeycomb structure mounted on the spar tube.

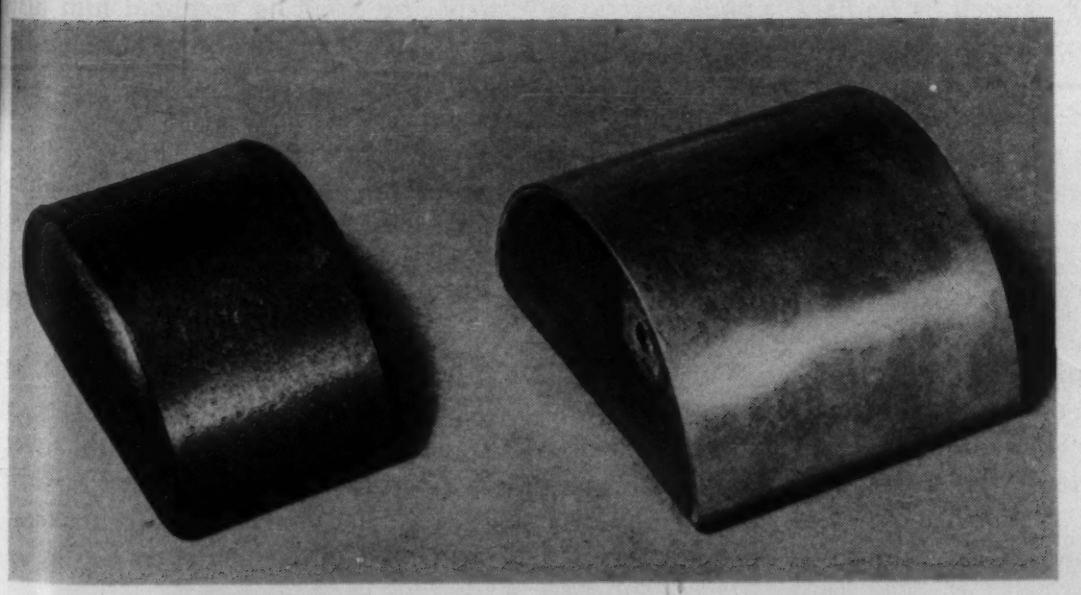
The Rockrite process is claimed to cold forge the tube and impart a better grain analysis to the metal to improve the structural strength of the spar tubing. Piasecki also reports that the better control of dimensional tolerances, wall thickness and concentricity possible with this process have reduced final machining needs.

The Rockrite process cold forms and cold sizes tubing by rocking semi-circular semi-tapered dies back and forth over the tubing, forcing the metal against a mandrel which controls the inside diameter.



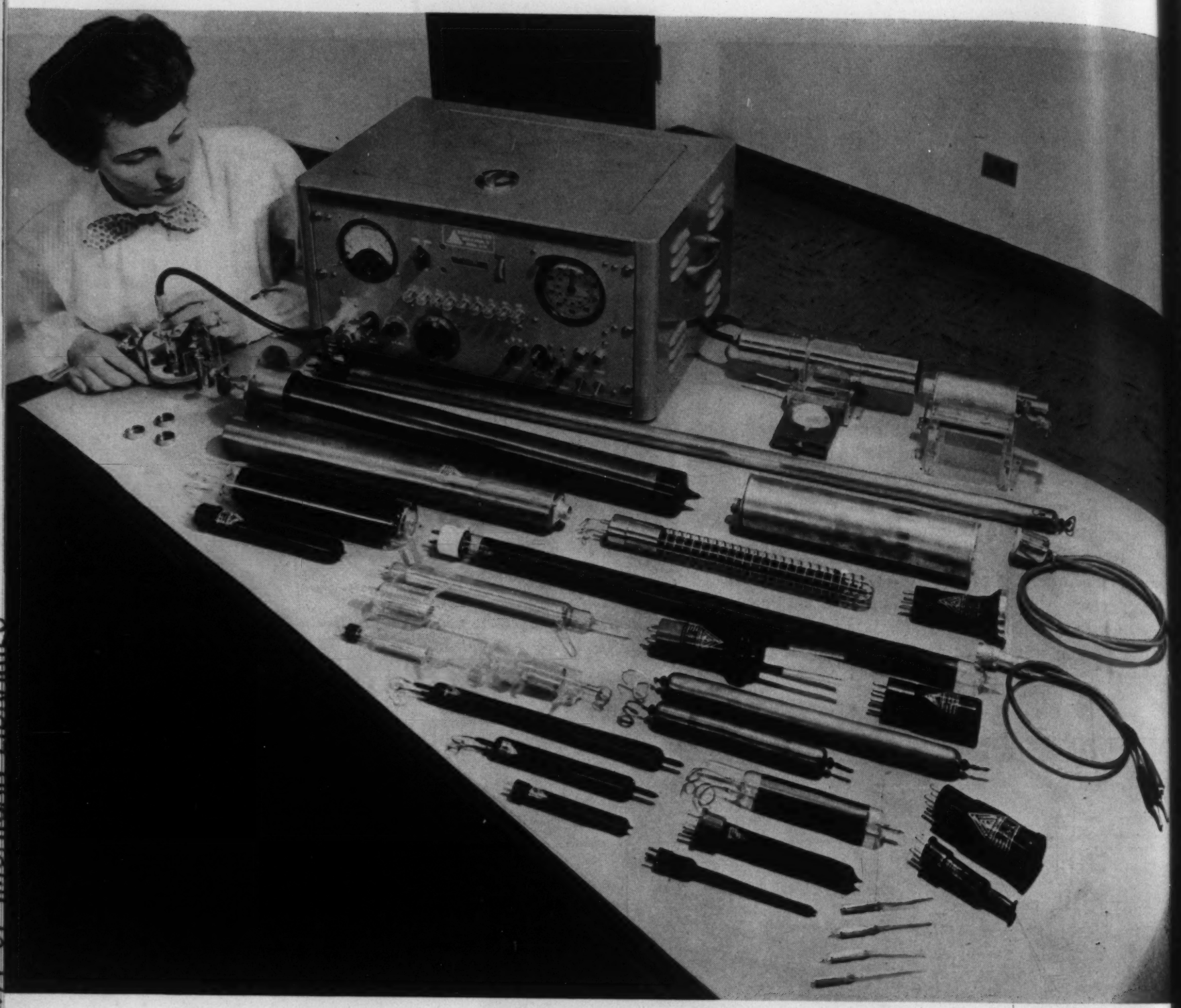
PRECISION CAST WELD ARM JAWS In the automatic cutting and welding machines which produce lead-in wires for electric light and photo flash bulbs, small weld arm jaws caused continual trouble. They face high temperature, galling, spark erosion, abrasion, weld spatter. In spite of shutdowns for cleaning, they required frequent replacement. It took seven machining operations to make the tool steel jaws. International Nickel Co. engineers designed a precision cast S monel part. These jaws cost 20 to 25% less and were hard, non-galling and heat resistant.





CELLULAR RUBBER CARBURETOR FLOATS The Revere Corp. of America formerly used carburetor floats made of metal. A number of advantages were found in changing over to molded closed cellular rubber floats (dark parts in the pictures). First of all, there was a substantial reduction in material costs with closed cellular rubber. Inspection costs were lower and the rejection rates dropped. Rejection had been fairly high on metal floats due to the difficulty of producing a perfect air-tight weld on the seams. The cellular rubber also allowed better density control of the final float assembly. The end product also has increased reliability. From a production standpoint, the conversion to closed cellular rubber has released for other purposes, space and equipment formerly used to weld and test metal floats. The rubber floats are made by the Sponge Rubber Products Co.

Materials at Work



COLLOIDAL GRAPHITE COATED GEIGER TUBES Colloidal graphite in water, manufactured by Acheson Colloids Co. under the trademark Aquadag, is used by Radiation Counter Laboratories, Inc. in some types of Geiger-Mueller counters.

The Geiger-Mueller tube consists of a cylindrical container of Pyrex glass inside of which is mounted a tubular conducting sheet serving as a cathode with a coaxial anode wire. In operation the counter tube is connected to a suitable amplifier and recording device and is energized by the application of 1000 v between wire and cylinder. The passage of an ionizing particle causes a momentary discharge in the counter, which is triggered off by one or more electrons. This discharge causes a momentary voltage pulse to appear on the wire. This pulse trips a mechanical counting device or registers on some other form of recorder.

The procedure is to apply to the interior walls of the glass envelope a conductive coating of colloidal graphite. Being electrically conductive, chemically inert and low in photoelectric sensitivity, the resulting graphoid film plays various roles, among which are the retarding of secondary emission, the adsorption of gases, and the ability to serve as an electrical conductor.

The graphoid is highly resistant to oxidation, acquires better properties when baked, and has a low coefficient of expansion. The fine particle size of an aqueous dispersion of colloidal graphite, together with the protective colloid it carries, also makes unnecessary the use of binding agents.

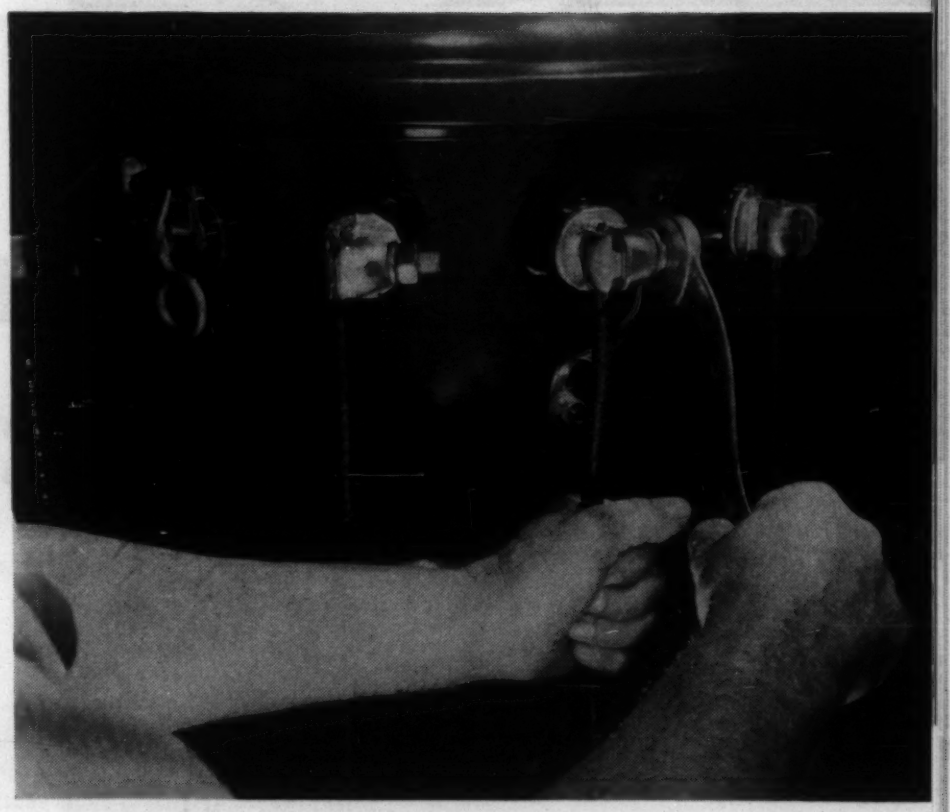
When graphoid films were first adopted, they were employed primarily for their dark color and were used in tubes which had been previously coated with silver. It has since been found that the graphite deposits are sufficiently conductive to make unnecessary prior treatment of envelopes with metallic elements.

RUBBER RADIATOR CAP SEALS Hycar rubber, a product of B. F. Goodrich Chemical Co., meets the sealing requirements of pressurized automobile radiator caps made by the Stant Manufacturing Co.

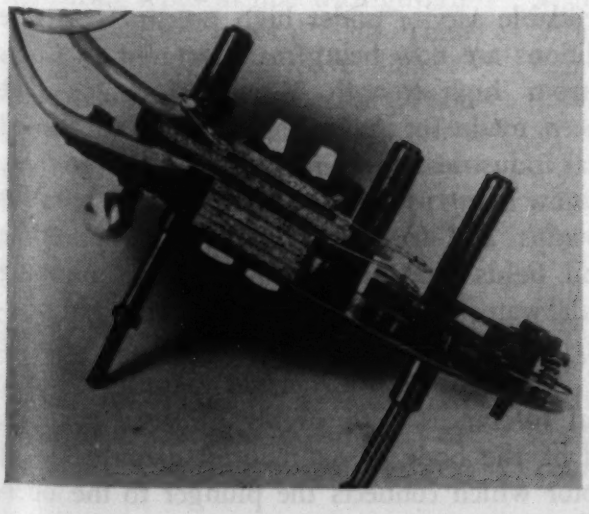
A rubber pressure seal must not stick to the brass radiator filler neck after long contact under spring pressure in the presence of heat alone or heat and moisture. Sticking would prevent the control valve from opening under extremely low pressure such as 1½ to 8 psi. The tendency for adhering to metal is eliminated since Hycar compounds do not promote corrosion.

The rubber gasket must not swell, shrink, soften, harden or crack under severe service conditions—including use in hot and cold water, alcohol or chemical-based antifreeze solutions, and mechanical abrasion produced by fastening and removing the pressure cap. Hycar resists oils, acids, abrasion, extreme temperatures, and is well suited for this application. Good compression set properties and resistance to cold flow insure a perfect seal.

Surface perfection, cleanliness and close tolerances of the rubber seal are required to permit the normal operating pressure in the cooling system. The seals are molded by Acadia Synthetic Products Div. of Western Felt Works.

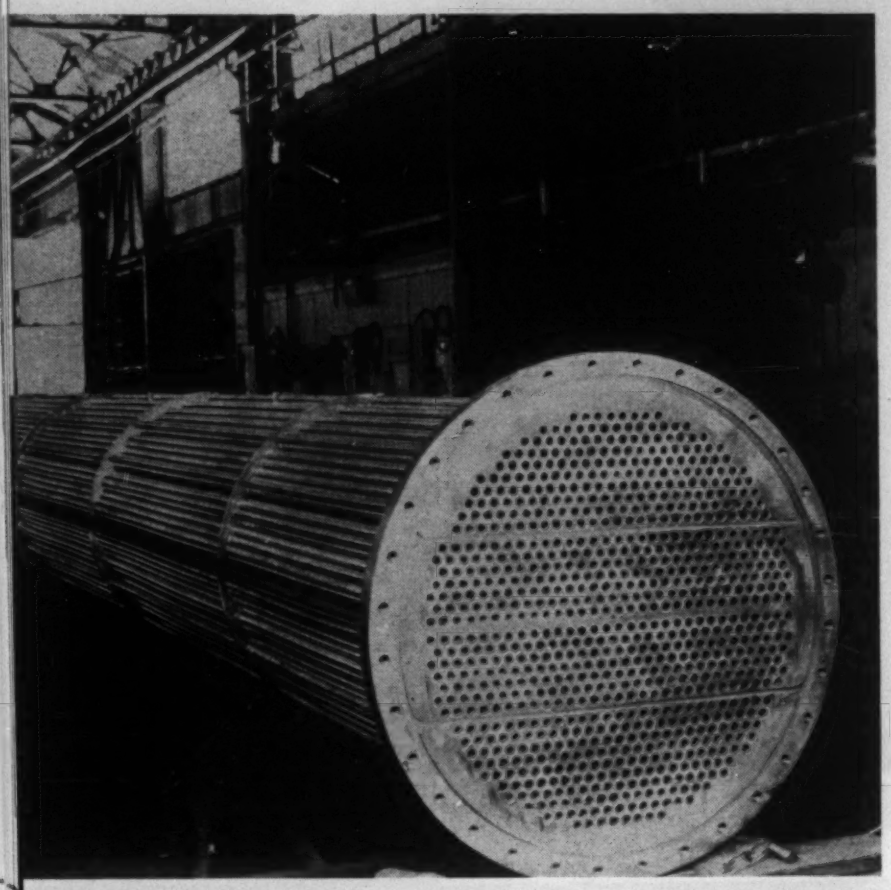


ALLOY TERMINAL EYEBOLT A transformer terminal eyebolt is made of the high strength and noncorrosive alloy Strenicor by the General Electric Co., Distribution Transformer Dept. Composed of copper, nickel, silicon, and a small amount of iron, the alloy is not susceptible to stress corrosion or season cracking when clamped to any tension within the ultimate strength of the material. When made by sand casting, the alloy has a tensile strength of 90,000 psi and a yield strength of 70,000 lb; made by hot forging, it has a tensile strength of 107,000 psi and a yield strength of 83,000 lb. Strenicor was developed by General Electric in cooperation with Revere Copper and Brass, Inc.



NYLON ELECTRIC SWITCH RIVETS A switch assembly fastened with nylon rivets is now being used by a leading clock manufacturer to provide longer life and greater assembly security than with materials previously used. The rivets are solid round head rivets, each about ¾-in long, cut on automatic screw machines from 3/16-in. nylon rod provided by The Polymer Corp. of Pennsylvania. The switch contacts are supported between small laminated phenolic stamped wafers, and the whole assembly is held together by two nylon rivets fastened by Tinnerman nuts. A feature of this method of fatsening is that the nuts are driven instead of spun onto the nylon rivets. When driven on, the resiliency of the nylon provides spring back after compression, thus holding the nuts firmly. The application has received Underwriter's Laboratory approval for 110-v a.c. current.

Materials at Work



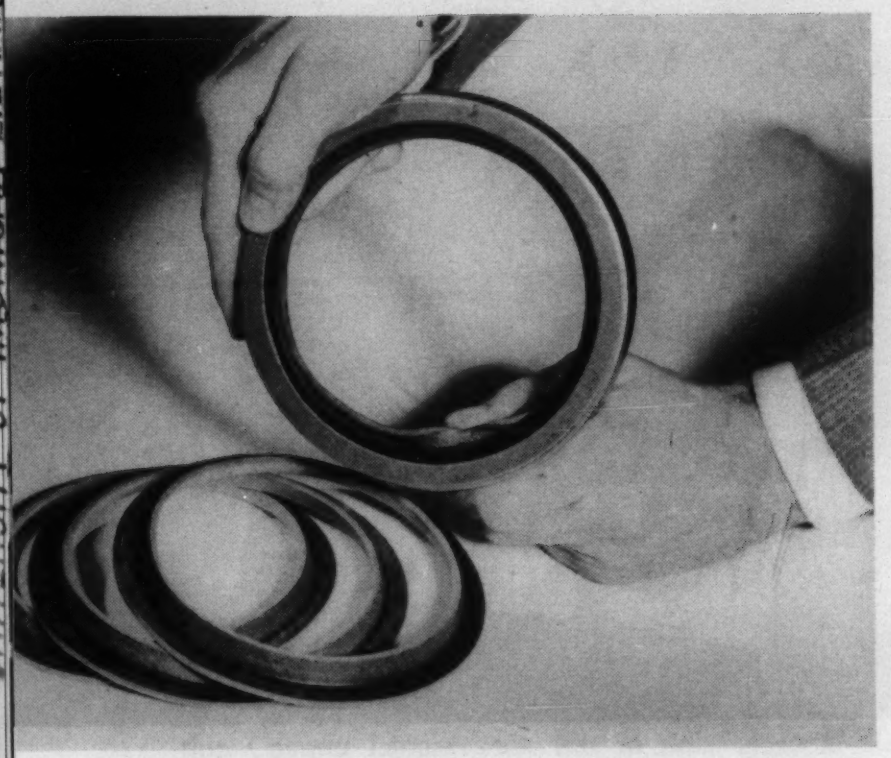
WELDED ALUMINUM HEAT EXCHANGER TUBES

A low price tag, plus protection against corrosion, is the story of welded aluminum heat exchanger tubes, now produced and marketed by Aluminum Co. of America. The tubes are made by longitudinally butt welding Alclad 3S-H12 sheet, rather than drawing seamless aluminum tubes. The same process can be used in making tubes for applications other than heat exchangers.

In the two standard sizes now available, 1-in. outside dia with 0.049- and 0.065-in wall thicknesses, welded tubes cost 20% less than seamless aluminum tubes and less than tubes of other commonly used metals. The welded heat exchanger tubes also have the protective Alclad coating on both the inside and outside surfaces rather than on the inside only, as in seamless aluminum tubes.

Weight tolerances, tube expansion, hydrostatic pressure tests, and dimension tolerances (except for slight deviations in the weld area) are the same for 3S-H12 welded tubes as for seamless 3S-H14 tubes. Typical tensile strength for Alclad 3S-H12 welded tubes is 17,000 psi and yield strength 14,000 psi. In trial installations, though allowable internal working pressures generally average two-thirds those of seamless tubes, the welded tubes have performed satisfactorily.

Corrosion tests made by Aluminum Research Laboratories on the new tubes have shown that the Alclad coating gives protection to the weld area. During manufacture of the tubes the outside weld bead is removed and the small inside weld bead is flattened.

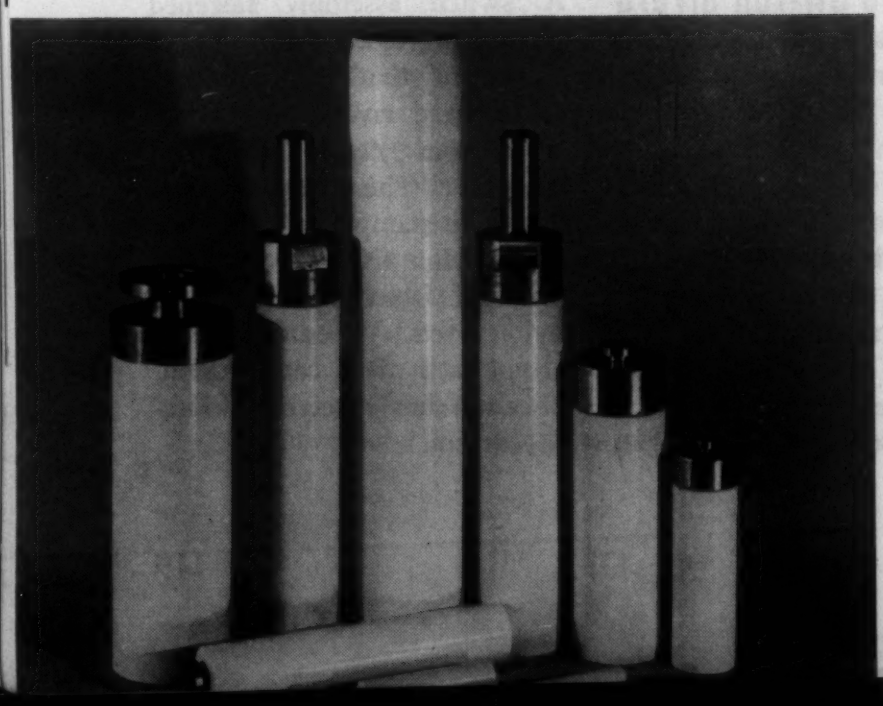


LEATHER-RUBBER OIL SEAL

A combination leather and rubber oil seal has been developed by the Allis Seal Corp. for use in the tracklaying wheels of the Army's medium tanks. The leather inner seal is coated with a Geon vinyl plastic latex to insure proper lubrication, and an outer seal of Hycar American rubber keeps out dirt and dust. Both Geon and Hycar are products of B. F. Goodrich Chemical Co.

This seal must stand up under the severest weather conditions and continue to operate perfectly in temperatures ranging from the arctics to the tropics. It is subjected to a variety of elements such as snow, salt-water, mud and sand.

Not only is the sealing action improved, but the lifetime is lengthened by coating the leather with an oil and abrasion resistant Geon polyvinyl plastic latex. Geon adds body to the leather and helps it hold its shape as well as regulating the amount of oil used for lubrication.



CERAMIC PUMP PLUNGERS

Ceramic pump plungers which give dependable service under high pressure corrosive or abrasive conditions are now being manufactured by Coors Porcelain Co. from high-strength alumina ceramic. The plungers have been made for special applications in the oil field and chemical industries. Sizes range from 7/16 to 5 in. in dia. They are now being used in the chemical industries for proportioning pumps and corrosive and abrasive pumping work. In the oil fields they are being used for pumping cement, mud, salt water and other abrasives at high pressures. Basic design of the plungers is a solid piece of ceramic bar stock which is ground on the outside diameter to very close dimensional tolerances with highly polished surfaces. Usually one end of the body has a reduced diameter to fit into a steel adaptor which connects the plunger to the operating mechanism.

Induction hardening of diesel-electric drive gears at Allison Div., General Motors Corp.

Induction Hardening Boron Steel Gears

Changing from (1) a low alloy to a plain carbon boron steel and (2) from a two-piece assembly to a solid forging, also required changes in the hardening technique to assure high surface hardness over a tough core.

by GEORGE VAN CAMP,

Allison Motors Div., General Motors Corp.

● THE AVAILABILITY OF some of the alloy steels has become more uncertain recently, and there has been a trend toward lower-alloy or boron-containing types in line with governmental materials control plans. These changes in materials have induced some changes in both the design and processing of the large heavy drive gears produced at the Allison Motors Div. of General Motors Corp. for diesel electric locomotives made by another division of General Motors.

Gears are standardized devices for power transmission, with general strength requirements that are well understood. The teeth must have rather high hardness to provide wear resistance, and the body of the gear should have good toughness to impart the necessary resistance to shock.

High surface hardness over a tough core can be obtained by developing a differential chemistry in the steel, as in carburizing or nitriding, or by using a process in which heating is localized as in induction hardening or flame hardening. Choice of method depends upon results required, relative costs of the methods, and materials available.

The gears are about 28½ in. outside dia, 9¼ in. dia in the bore, and about 5 in. wide across the face of the teeth. They weigh about 460 lb each. Formerly made of 4047 steel, these gears were converted to a 5046 composition, and then, as alloying metals were restricted in use, to a plain carbon composition containing a little manganese, with boron to increase the hardenability. This is 14B45, and is now in satisfactory use. The gear was redesigned about the same time, and was converted from an assembly, in which a ring was shrunk over a spider, to a solid forging. The one-piece gear is more economical. Now, as formerly, the teeth are hardened by induction heating.

These diesel drive gears are made in several sizes, having from 52 to 68 teeth. The 62-tooth gear is about average in size. All are made by the same method, and the same equipment is used for hardening the teeth

on all the gears. The blanks are forged by a supplier, are semifinish-machined over all surfaces requiring refinement, and the hub is then finish faced and bored. The teeth are next hardened, and the final operation is a finish grind over the teeth. The gear is assembled onto its shaft by a press fit at 55 tons minimum force.

Hardening Method

For induction hardening, a specially adapted motor-generator heating unit operating at a frequency of about 10,000 cycles per sec is used. The size of the piece requires a high energy input to bring it to temperature in a reasonable time, and the equipment is rated at about 250 kw. It is run from a 440-volt line.

The semifinish-machined gear is placed onto a circular table in the induction heating unit, and the table is revolved slowly, at about 5 rpm, as the workpiece is raised into the field of the induction coil, which is formed of five turns of water-cooled copper tubing. The air gap is held to less than 5/8 in. in all cases. About 50 sec is required to heat the toothed rim of the gear to a temperature of 1540 F. The speed of the platform is then increased to about 33 rpm, and the platform is lowered out of the field. A special indexing block is used at one side of the gear to insure its proper positioning. The operator positions the gear for lowering into the quenching fixture, using a hand bar to make any slight rotary adjustment necessary.

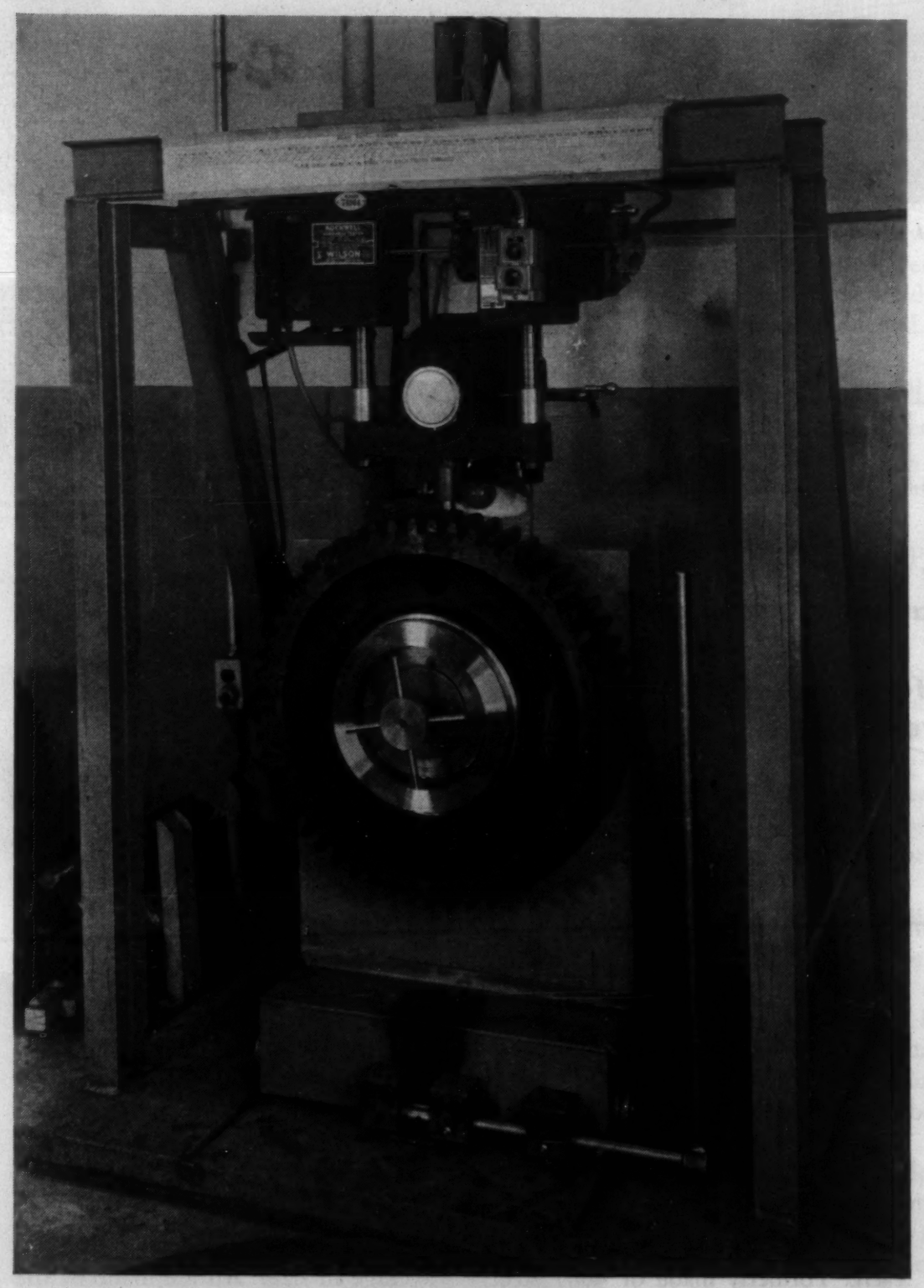
The gear is quenched in oil applied under pressure from a quenching fixture located in the base of the induction heating unit. After indexing, the platform is lowered into this fixture. Oil is held at 120 F ±10 F, and greater variation is prevented by a closely controlled heat exchanger located in the pit under the unit operating floor. Other actuating equipment is located in this pit also.

When fully quenched, the gear is removed from the hardening unit and taken to a hardness testing instrument converted from a standard unit to permit taking hardness readings upon the area at the root of the gear teeth. As quenched, the root hardness is Rc55.

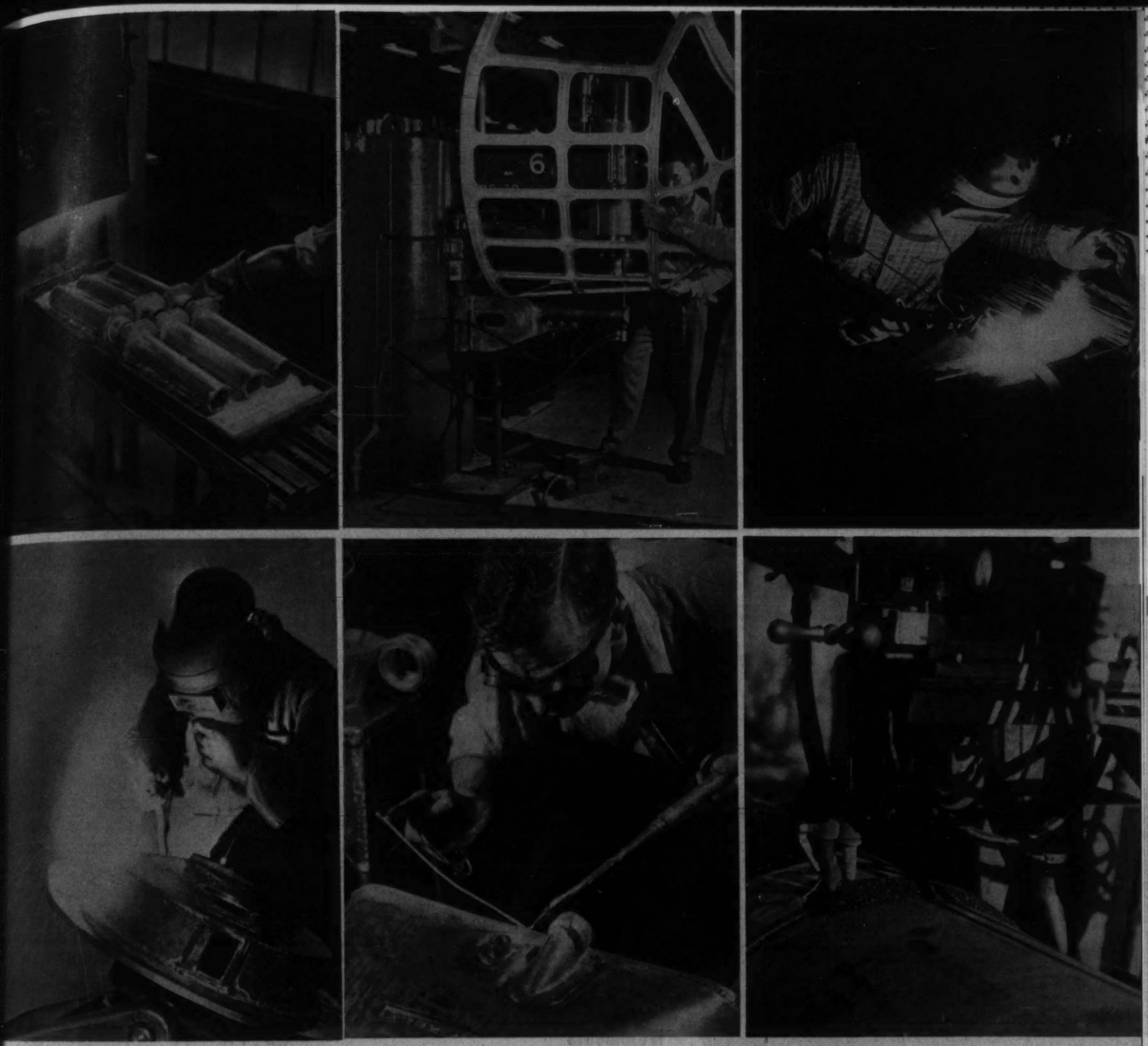
One advantage of induction hardening of the gear teeth is that there is little or no effect upon the shape and dimensions of the bore of the gear. These must be closely held to insure a satisfactory shrink fit over the shaft upon assembly. Dimensions for the bore of a typical gear in the series are 9.240 in. dia, with a tolerance of +0.000, —0.001 in. Over the outside diameter a tolerance of —1/32 in. is permitted before the finish grind, and —0.028 in. after grinding.

The finish grind over the teeth removes 0.015 to 0.020 in. of metal, but careful studies of surface hardness have shown that the drop in hardness that might be expected to result from removal of this amount of the surface does not materialize. Removal of even 0.050 in. of metal in test pieces causes a drop to only about Rc45.

Performance of the boron-containing steel has been satisfactory in this application. The gears of 14B45 steel heat to austenitizing temperature in the same time as did the 5046 gears formerly hardened in the same unit. The 14B45 steel is probably a little easier to machine and seems to hold hardness better at temperatures up to 500 F. Heat treatment response generally has been good, but results have occasionally been somewhat erratic, with no positive correlation between the changes in results and changes in steel composition.



Rockwell hardness tester was adapted for the determination of the hardness of the roof areas of the gear teeth.



Weldments are produced by many different welding and brazing methods.

Welded and Brazed Parts

by H. R. Clauser, Managing Editor, Materials & Methods

Welding constitutes a basic production or fabrication method whose end product is a metal part or form, commonly called a weldment. Therefore, weldments should be considered along with castings, forgings, stampings, etc., when a part or product is being planned. Welded or brazed fabrication frequently makes possible designs or redesigns which save money and/or improve performance.

This Manual will help the engineer and designer determine whether or not his product could possibly be made as a weldment. It provides information on:

- ***Shapes, Sizes, Thicknesses That Can Be Welded***
- ***Weldable Materials***
- ***Properties and Characteristics of Welded Joints***
- ***Joint Designs and Welds***
- ***Cost Considerations***
- ***Typical Applications***

MATERIALS & METHODS MANUAL No. 88

This is another in a series of comprehensive articles on engineering materials and their processing. Each is complete in itself. These special sections provide the reader with useful data on characteristics of materials or fabricated parts and on their processing and applications.

NOVEMBER 1952

Introduction

Welding is commonly regarded merely as a method for joining metals together. But the welding processes, which include brazing, resistance, gas and arc methods, considered as a group mean much more than this. In a broader and more useful sense, welding constitutes a basic production or fabrication method whose end product is a metal part or form, commonly called a weldment.

As metal forms, weldments, therefore, must be considered along with castings, forgings and other fabricated forms whenever a metal part or product is being planned. Weldments regarded in this light will frequently lead to design of new parts or redesign of existing ones with consequent savings in costs, and improved performance.

The purpose of this Manual is to provide information on the characteristics, properties, capabilities and limitations of weldments to help the engineer and designer determine whether or not his products could be designed to advantage for welded or brazed fabrication. The article does not attempt to tell how to design a weldment. Nor does it attempt to tell how to weld or to give specific technical data on weldability of materials and the various welding processes. These subjects logically should not be a matter of concern until after a weldment has been decided upon, and they are amply covered in a number of handbooks.

Selection Factors

The first consideration in deciding whether or not a weldment can be used in a particular application is, will it meet the service requirements? The material or materials used in a part are selected largely for their ability to meet the service conditions. Therefore, not only must the material be weldable but the welded joints must meet satisfactorily the service requirements. Thus, depending on the application, any or all of the following weld joint properties must be considered: (1) mechanical properties such as strength, ductility and impact resistance; (2) physical properties such as electrical and thermal conductivity; (3) corrosion resistance; and (4) appearance.

To be successful, the weldment must also fulfill the design requirements of the product. These may include shape, size, thickness, tolerance limits, and weight considerations. Ability to meet the production rate is another factor to consider when volume production is required. Available facilities, both forming and welding, are another important consideration regardless of whether the weldments are to be made in the plant or produced in a commercial weldery. Finally, total cost of producing the weldment must be considered.

Most of the above selection factors are covered in detail in the following sections.

Advantages and Scope of Weldments

The advantages of welding as a product fabrication method are well-known. Where applicable, welding can frequently cut costs by (1) simplifying fabrication and assembly; (2) reducing finishing operations; (3) affording flexibility and freedom of design; (4) permitting changes in design without costly tooling changes. Also, where welding can be suitably employed, the method can often improve product quality by (1) increasing strength or providing maximum rigidity with less material; (2) reducing weight and/or size; (3) improving appearance; and (4) producing uniform quality products. Other possible advantages of welding are: it allows a wide choice of material; and it permits the use of dissimilar materials and different types of metal forms in the same product.

The scope of welded fabrication is so broad that there is hardly a segment of the product manufacturing industries that does not use welding in some way. Space permits only a brief mention of some of the typical fields of application. The automotive industry makes use of all the welding methods in the production of automobiles, buses, trucks and trailers. The closely allied farm equipment industry also applies welding widely. In the aircraft industry welding is used in a host of applications, including engine mounts, landing gears, frames, engine parts, fittings, etc. Welded fabrication is now widely used for pressure vessels, boilers, tanks, containers of all kinds, and piping. The chemical and processing equipment fields are also making profitable use of welding. The railroad equipment shops and shipbuilding yards are also large users of welding.

Welded and brazed parts are being widely used in appliances of all kinds, in electrical and electronic equipment, and in light and heavy machinery construction. It is probably in these fields of product manufacture that the greatest potentialities exist for new and increased use of weldments.

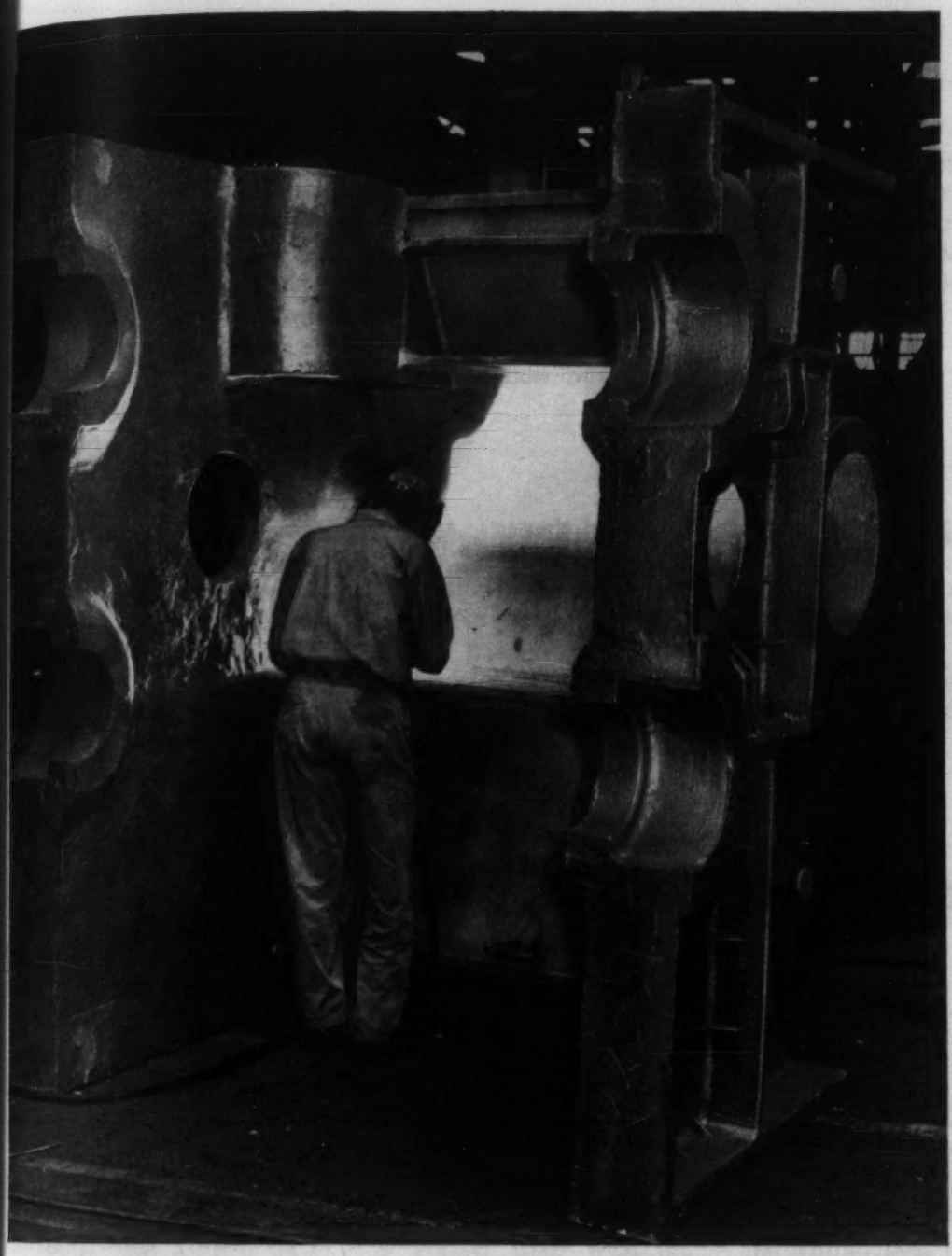
Shapes, Sizes and Thicknesses That Can Be Welded

Because of the great versatility of available joining methods, a wide range of thicknesses, sizes and shapes can be fabricated by welding. Welded parts and products vary from extremely delicate devices to huge, ponderous parts. For example, wires as small as one and one-half mils used in tubes and light bulbs, and products as large as railroad cars and automobile bodies are successfully welded.

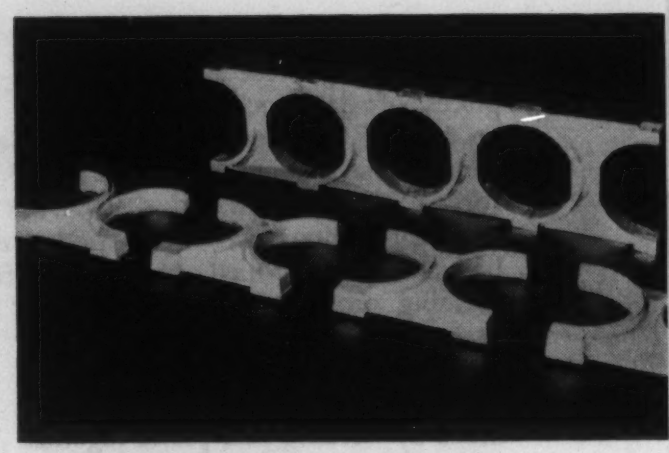
While it is impossible to give the exact limits on thicknesses that can be successfully welded, it is safe to say that parts as thin as one mil and as thick as 20 in. have been welded commercially. However, this does not mean that all materials can be successfully welded in any thickness. The thicknesses that can be welded varies considerably from metal to metal. The weldable thicknesses also depend upon the welding process.

Dissimilar thicknesses can also be joined by welding and brazing. The ease with which thin to thick sections can be welded depends upon a number of factors including type material involved and welding process.

One of the principal reasons why welding provides a large amount of flexibility and freedom in design is because a wide variety of metal forms



This structure was originally made of a single steel casting. To overcome the problems of cleaning, shrinkage and maintaining dimensions, it was redesigned making the two sides steel castings and joining them together with a shaped steel plate. (Continental Foundry & Machine Co.)



Drop forgings (foreground) are flash welded together to produce this weldment. Design freedom in shaping for minimum weight and maximum predictability results. (Lukens Steel Co.)

This component for a weldment was flame-cut to shape from hot rolled plate. (Lukens Steel Co.)

and shapes lend themselves to welded fabrication. Practically all the common metal forms—plate, sheet, strip, bar stock, extrusions, castings, stampings, forgings and rolled sections—can be utilized alone or in combinations, in whatever way best meets the requirements of the product.

The metal forms commonly used in weldments are described briefly below.

Plate, Sheet and Strip

Plate and sheet stock are probably the most widely used forms for weldments. This is particularly true for medium and large sized structural parts. Flat stock in the common ferrous and nonferrous metals is available in a wide range of sizes and thicknesses. This, plus the many available forming methods, makes possible almost any conceivable size or shape. Here are the common forming methods used in the fabrication of weldments.

Shearing is probably the most economical means of shaping flat stock but is limited to relatively simple thin shapes.

Flame cutting is a common and economical method for cutting flat shapes of ferrous metals where the number is small and the configuration and thickness is such that shearing cannot be used.

Blanking or punching can be used when the quantity is large enough to justify the die cost. It produces flat shapes to closer tolerances and in less operations than shearing.

Formed plates and bars are used to advantage in many weldment applications. By making angular bends, for example, using a bending press or brake, the amount of welding can often be reduced. Also, designwise, a bent component is more rigid than a flat one, and can assist in controlling shrinkage or distortion from welding. Cylindrical shapes are also readily made as weldments by forming the plate, sheet or bar stock on bending rolls. A wide variety of rings and bands are formed in this way and then arc or flash-butt welded to make a homogeneous circular part.

Spun or flanged plate provide curved sections. By their use, the

amount of welding is often reduced and rigidity provided. Two or more pieces of flat stock can sometimes be welded together and then spun, flanged, stamped or drawn, or even forged into the finished shape. In such applications, weld quality must be closely controlled so that the forming properties are the same or very nearly the same as the metal being joined. Hemispherical heads for tanks and vessels are commonly made by welding flate plates together and then spinning to finished shape.

Stampings and pressed shapes can be used where the quantity of parts justifies the tooling or die costs. Where applicable, their use results in lower unit cost, relatively close tolerances, and makes available wider choice of shape and design. Weldments made up of resistance welded stampings can often replace small forgings and castings. In such cases, the stampings are produced with coined projections and then fabricated by projection welding.

Castings and Forgings

Large and small castings and forgings are used extensively in weldments. Their use is determined by the service conditions or where either the size or quantity justify the die or pattern costs.

Weldments composed of castings or forgings are often the best solution for parts whose size or shape make a one-piece casting or forging too costly or impossible. They are also used extensively for intricately shaped parts where plate fabrication is not feasible.

Extrusions and Tubing

Extrusions and tubing are frequently used in fabricating parts by welding. A countless number of extruded shapes are available in the light metals and copper alloys. Tubing of many sizes and shapes is available both in ferrous and nonferrous metals.

Rolled Shapes

Standard and special rolled shapes are commonly used in design of weldments. The standard shapes, in particular, are readily available, are mass produced and, therefore, relatively low in cost. Where sections can be used they often permit development of a part using a minimum of forming operations and a minimum of welding. Rolled shapes also can often add rigidity and reduce shrinkage and/or distortion.

Selecting the Proper Forms

Selection of the metal forms to use in a weldment is, of course, first governed by the available facilities. Whether the fabricating is done in the engineer's shop or a commercial weldery, he should be acquainted with the type of forming, forging, cutting, shearing and casting equipment. The more flexible and extensive the facilities, the more freedom in design. When relatively large quantities are involved, it is also important to know about the extent of the facilities. Without exception, the engineer or designer should consult with the engineers in the weldery.

A second consideration in selecting and designing the components of a weldment is the service requirements. The forms best suited to meet the performance requirements should be used. For assemblies in which the service requirements differ from one part or one section to another, two or more different materials and/or forms can often be used to best fit the needs of the application. Or, to meet particular design requirements, two or more different forms may be used to advantage. In general, however, for economy, the number of different kinds of metal forms used should be kept to a minimum.

Finally, economy must be considered in selecting weldment components. In every design the engineer should choose the metal forms that keep the amount of welding to a minimum. One of the ways of doing this is to use forming operations, which cost relatively little, to eliminate welds. Also, by judicious design, welds can frequently be located in areas of low stress and thus save on weld metal. Another economy measure is to design for automatic and semi-automatic welding where size and quantity permit and where production warrants it.

In the production of large weldments it is frequently good practice to break the product down into subassemblies suitable for production equipment.

Weldable Materials

In planning and designing a welded or brazed product, the material is seldom selected solely on the basis of its weldability. More often, service requirements and other considerations dominate and weldability becomes a matter of "making it work." Fortunately, most of the commonly used engineering metals can be welded or brazed by at least one of the many available joining processes. But they cannot all be welded with the same ease; their weldability varies considerably.

Although it would be desirable to give specific data on welding characteristics, it is important to realize that the weldability of materials cannot be definitely indicated for all service properties. There are too many variable factors involved such as thickness, location of weld, condition of metal or previous heat treatments, and design details that influence a material's welding characteristics. Therefore, the best that can be done here is to indicate in a general way the relative ease with which the common engineering metals and alloys can be welded by the various methods. This has been done by means of the tabulation that follows. This is not intended as a complete and final list, but more as a general guide to show which metals can be successfully welded when proper design, techniques and procedures are used. For more complete details on weldability, the references at the end of this Manual should be consulted.

When referring to the tabulation, the definitions of the following terms should be kept in mind:

Readily Weldable means the material is widely and easily welded.

Weldable means the material can be welded, but special precautions must usually be observed.

Difficult means the material can be welded if necessary, but only if special precautions are taken. Not recommended for quantity production.

Arc Methods	Gas (Oxyacetylene)	Resistance Methods	Brazing
Low Carbon Steel (up to 0.30 C)			
Readily weldable with all arc welding processes. Most commonly used are metal arc, submerged arc and atomic hydrogen. Weldable with inert-gas arc. Heavy sections may require preheat and interpass temperature control. Stress relief anneal is usual for pressure vessels and complicated structures.	Readily weldable with welding rods of same composition or using nonferrous rods. Where preheating is necessary, it can be done with torch.	Readily weldable with all resistance processes. Where carbon is above 0.15% various postheat treatments can be applied, with same welding equipment, as part of welding cycle.	Readily brazed using common brazing alloys
Medium Carbon Steel (0.30 to 0.45 C)			
Weldable with all arc methods. As carbon increases, welding becomes more difficult and preheat and postheat treatment is necessary for best weld properties. Thinner sections readily weldable with low hydrogen electrodes.	Weldable with rods of same composition or nonferrous type. Same precautions apply as with arc welding.	Weldable by all resistance methods where proper pre- and postheating are used to prevent hardening. Flash and upset methods can be used over wide range of carbon content.	Readily brazed using common brazing alloys.
High Carbon Steels (0.50 to 0.80 C)			
Difficult. Only welded for relatively few applications. Preheat and post treatment required.	Difficult. Seldom used.	Difficult.	Can be brazed successfully using special techniques.
Low Alloy Steels			
Most hot rolled grades readily welded with metal arc. Submerged arc used on both hot rolled and heat treated grades. Atomic hydrogen, and inert-gas arc methods restricted to the lighter gages of hot rolled and heat treated grades. Preheating and post heat treatment usually required with all methods.	Hot rolled and heat treated grades are readily weldable. Heating of base metal is greater than with arc methods and heat treatable grades require postheat treatment to refine grain.	Readily weldable similar to low carbon steels. Where alloying constitutes cause hardening, post heat treatment required. Seam and projection methods usually limited to hot rolled grades.	Hot rolled grades readily brazed similar to carbon steels. Not generally used for heat treated grades where tensile strength over 100,000 psi required. Where heat treatment above 1200 F needed, can be done with special filler metal.
Stainless Steels—Nickel-Chromium (300) Types			
Readily weldable by metal arc, submerged arc, atomic hydrogen, and inert-gas arc methods. Where corrosion a factor, carbon content should be below 0.08 or 0.10% or use stabilized grades to avoid intergranular corrosion. Post heat treatment dependent on service conditions.	Readily weldable in thin gages (20 gage) although thicker sections can be welded.	Readily weldable by all resistance methods giving excellent weld properties. Close control of all welding factors is required.	Readily brazed with silver brazing alloys.
Stainless Steels—Straight Chromium (400) Types			
Weldable by metal arc, submerged arc, hydrogen and inert-gas arc methods. Preheating required except on thin stock. Anneal after welding usually required.	Weldable in thin gages.	Weldable. Susceptible to hardening, and post heat treatment either in machine or separately may be necessary.	Brazed with silver and other brazing alloys.

Arc Methods	Gas (Oxyacetylene)	Resistance Methods	Brazing
Cast Irons			
Weldable. Metal arc can be used successfully in applications where ductility of weld not required. Special care, preheating and post heat treatment necessary. Inert-gas arc finds very limited use.	Readily weldable with cast iron rods. Best method. Preferable to preheat entire casting except very thin sections. Sudden cooling after welding must be prevented. Postheat usually recommended. Braze welding using nonferrous rods suitable where weldment not subject to corrosion or thermal stresses.	Seldom used. Can be flash welded.	Difficult. Requires thorough surface cleaning. Quality controlled cast irons and nickel containing types more easily brazed.
Cast Steels			
Weldable with metal arc and submerged arc methods when carbon does not exceed 0.25%. Welded similar to plain carbon steels. Preheat and post heat treatment required for best results. Special precautions required when carbon is over 0.25% and for high manganese and other all steel castings; low hydrogen electrodes recommended.	Weldable. Generally limited to thinner sections and to ferritic grades. Same procedures as for wrought steels are applicable. Often used on air hardening steels regardless of thickness to eliminate preheating. Braze welding using nonferrous rods also applicable.	Weldable by flash welding method in mild, medium and some low-alloy cast steel grades, where air-hardening tendency not excessive. Post heat treatment may be necessary. Other methods not generally applicable.	Readily brazed, using the common methods. Suitable for mass production.
Aluminum and Aluminum Alloys			
Readily weldable with inert-gas arc method. Weldable with metal arc, carbon arc and atomic hydrogen methods. Some heat treatable alloys more difficult to weld than non-heat-treatable grades. Preheat helpful in some heavy sections. Post heat treatment only on heat treatable alloys.	Weldable in sections of about 0.040 to 1 in.	Readily weldable by spot, seam, upset and flash-welding. Precision control necessary to produce consistent high quality welds.	Most wrought alloys can be brazed commercially; *i. e.*, 2S and alloys of higher purity. Brazing of castings still developmental.
Magnesium and Magnesium Alloys			
Weldable by inert-gas arc process. Must be applied with care. Preheat particularly on heavy sections. Post heat treatment usually desirable.	Alloy containing 1.5% manganese (M1) in form of sheet, extrusions, castings most suitable. Others less satisfactory.	Alloys M1 and AZ31X in form of sheet and extrusions can be spot welded. Precision control necessary. Some use made of seam and flash welding also.	Commercial brazing limited to M1 alloy containing 1.5% manganese. Brazing of alloy AZ31 in developmental stage.
Copper and Copper Alloys			
Weldable with carbon arc inert-gas arc methods. More difficult with other arc processes. Welding of electrolytic copper not recommended where strong joints required.	Weldable with oxyacetylene and braze welding methods. Oxygen-bearing copper should not be oxyacetylene welded where strong joints required. Some of the lead containing alloys cause welding difficulty. Method not common for phosphor bronze and aluminum bronze.	Copper not weldable except by upset or modified flash upset methods. Brasses (except high lead brass) weld fairly well. Most bronzes are weldable except some of the high copper grades and those containing lead in excess of 3%.	Copper and the high copper brasses are readily brazed. Brazing of the bronzes varies considerably with the composition.

Arc Methods	Gas (Oxyacetylene)	Resistance Methods	Brazing
Nickel and Nickel Alloys			
Nickel, monel, Inconel readily weldable by all the arc processes.	Nickel, monel, Inconel weldable with oxyacetylene method. Braze welding also used.	Readily weldable by all methods. Inconel X, difficult.	Readily brazed.
Titanium			
Weldable by inert-gas arc methods with some difficulty.	Not used.	Weldable by spot and flash methods.	Can be brazed with difficulty.
Lead and Zinc			
Lead weldable by inert-gas arc.	Weldable.	Not used for lead. Difficult for zinc.	Not used.
Tungsten, Molybdenum			
Weldable by inert-gas arc and atomic hydrogen methods with proper precautions.	Not used.	Tungsten difficult to weld. Can be flash welded. Molybdenum can be spot, projection, seam and upset welded.	Readily brazed.
Gold, Silver, Platinum			
Atomic hydrogen and inert-gas arc methods are applicable.	Difficult.	Silver welded with difficulty.	Readily brazed.
Clad Steels			
Weldability depends on cladding. Metal-arc used on thicker than 18 gage. Atomic hydrogen used on silver clad and light gages of other clads. Submerged arc used on heavier gage metals for steel side. Inert-gas arc used on light gages.	Difficult. Seldom used.	Weldable. Copper clad difficult to weld.	Sometimes used on very light gages.

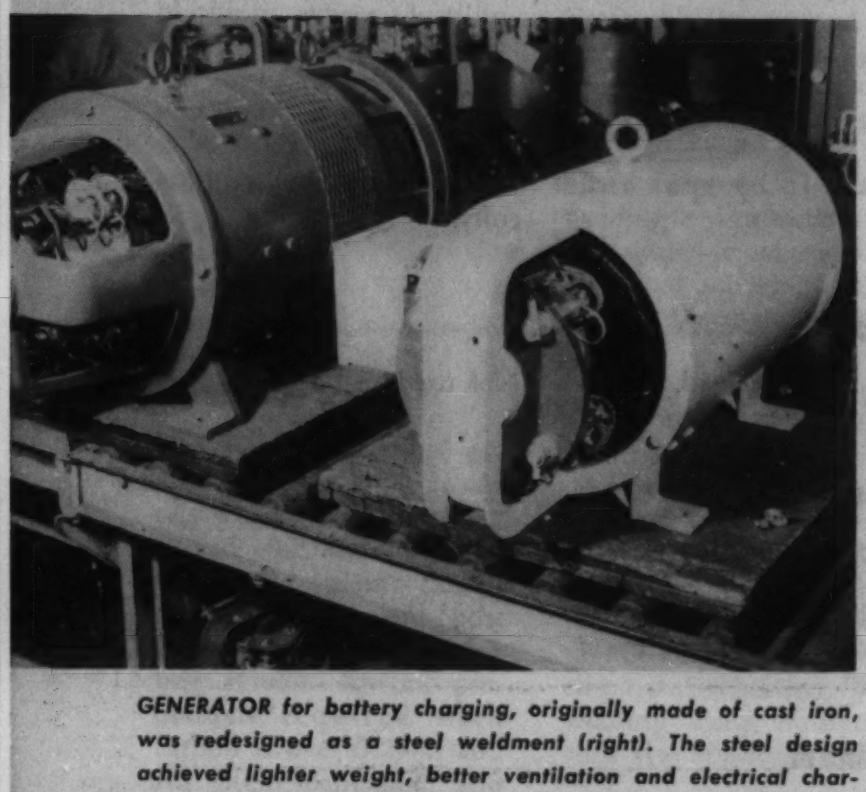
Properties and Characteristics of Welded Joints

The physical properties of a welded joint may or may not be the same as those of the base metals being joined. This is understandable because (1) if filler metal is used it may not be of the same composition as the base metal; (2) the deposited weld metal is, in effect, a casting and, therefore, its metallurgical structure will be different from that of the base metal; and (3) the heat from welding alters the metallurgical structure of the base metal adjacent to the weld. Thus, the properties of welded joints made by arc or gas welding methods can vary widely according to the weld metal composition, which is largely governed by the composition of the filler metal, and by its dilution with the base metal.

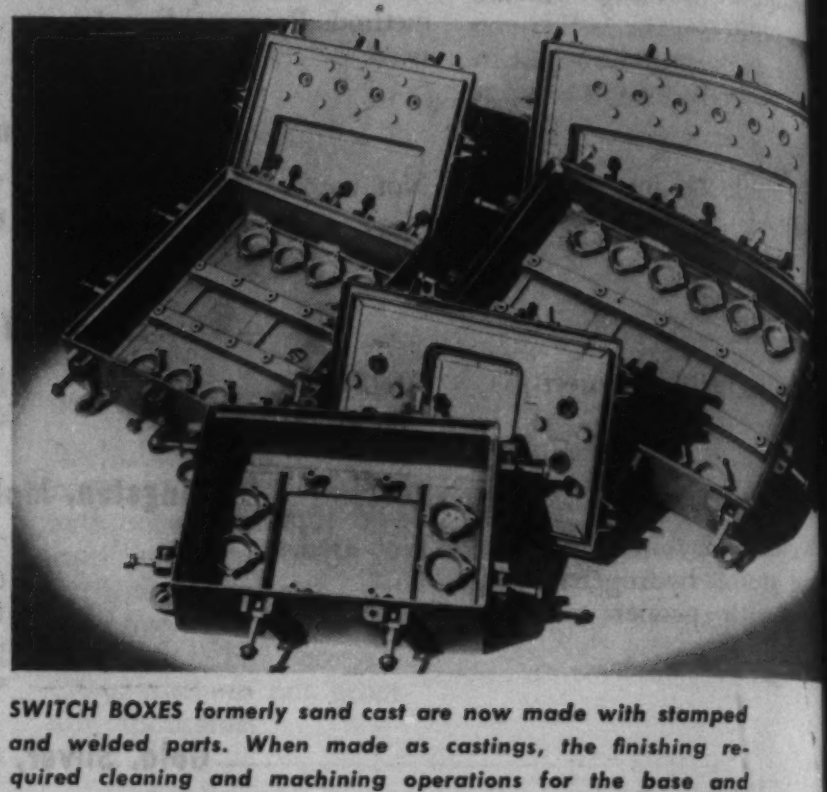
When no filler metal is added, as in resistance welding, the weld joint properties will vary, depending on joint design, heat of welding, and other factors. When dissimilar metals are welded by any method, the composition of the joint will vary according to the composition of the component parts. In the case of brazing, the low temperatures used generally do not affect the materials being joined, but the brazing alloy is seldom of the same composition as the base metal.

The above discussion is not to imply that welded joints cannot be made with properties close to those of the base metals. In most cases,

TYPICAL APPLICATIONS

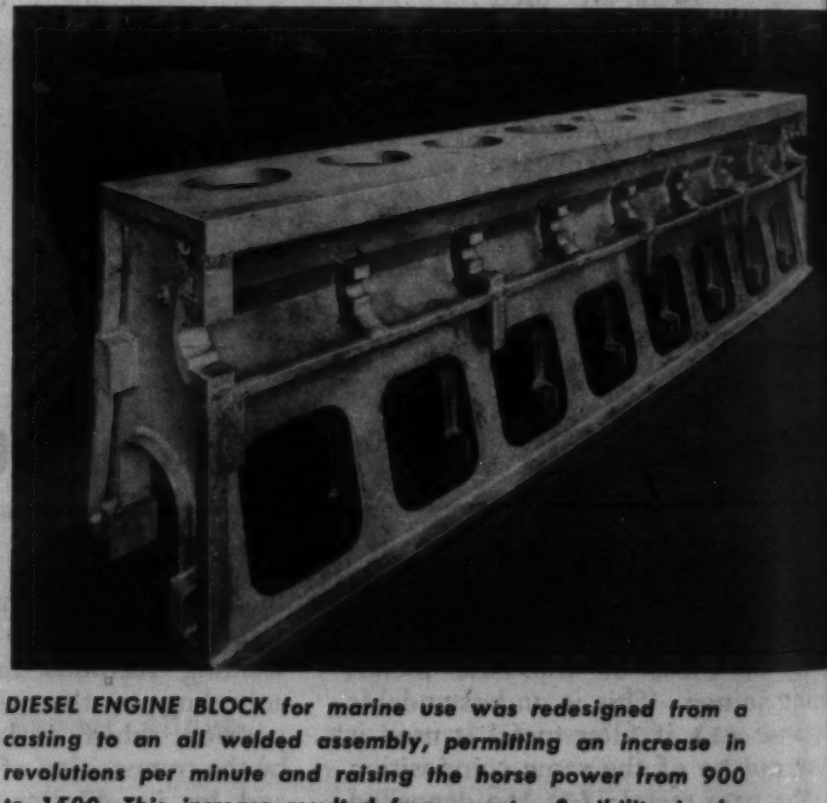


GENERATOR for battery charging, originally made of cast iron, was redesigned as a steel weldment (right). The steel design achieved lighter weight, better ventilation and electrical characteristics and neater appearance. Among other savings, cost reduction was realized in eliminating the surface filling operation necessary before painting the cast iron. Commutator and bracket savings were 50%; the motor and bracket savings were 10%. (Lincoln Electric Co.)



SWITCH BOXES formerly sand cast are now made with stamped and welded parts. When made as castings, the finishing required cleaning and machining operations for the base and for each part added to the basic casting. Holes had to be individually located, drilled and tapped. By use of stampings and welding, previously reamed and tapped lugs were fastened with one projection weld. Spot and projection welds replaced the holding bolts. (General Electric Co.)

WATER INLET RING for diesel engine is fabricated by flash butt welding a simple drop forging to a formed steel bar. The bar was bent into circular form, allowing a gap for the forging. Original design called for arc welding; however, it was found that flash butt welding the two joints on an automatic machine resulted in lower cost and better performance. (American Welding & Mfg. Co.)



DIESEL ENGINE BLOCK for marine use was redesigned from a casting to an all welded assembly, permitting an increase in revolutions per minute and raising the horse power from 900 to 1500. This increase resulted from greater flexibility in design and because less vibrations occur in the welded structure. (Graver Tank & Mfg. Co., Inc. and National Supply Co.)

by proper choice of filler metal and pre- and post-heat treatments, joint properties can be obtained which match those of the base metal closely enough for all practical purposes. In many applications the base metal and weld joint properties need not be similar and, therefore, no problem arises.

Strength Properties

Fusion Welds—As a general rule, static strength of welded joints in materials that are readily welded is at least equal the strength of the metal being joined. Where desirable or necessary, weld strength can be increased by increasing the yield strength of the metal deposited.

As mentioned previously, welds as-deposited have a cast structure. Thus, their ductility tends to be lower than that of wrought materials of same composition. However, filler metal is usually selected to match the ductility of the base metal. Ductility of welds can also be improved to the required level by post heat treatments or anneals.

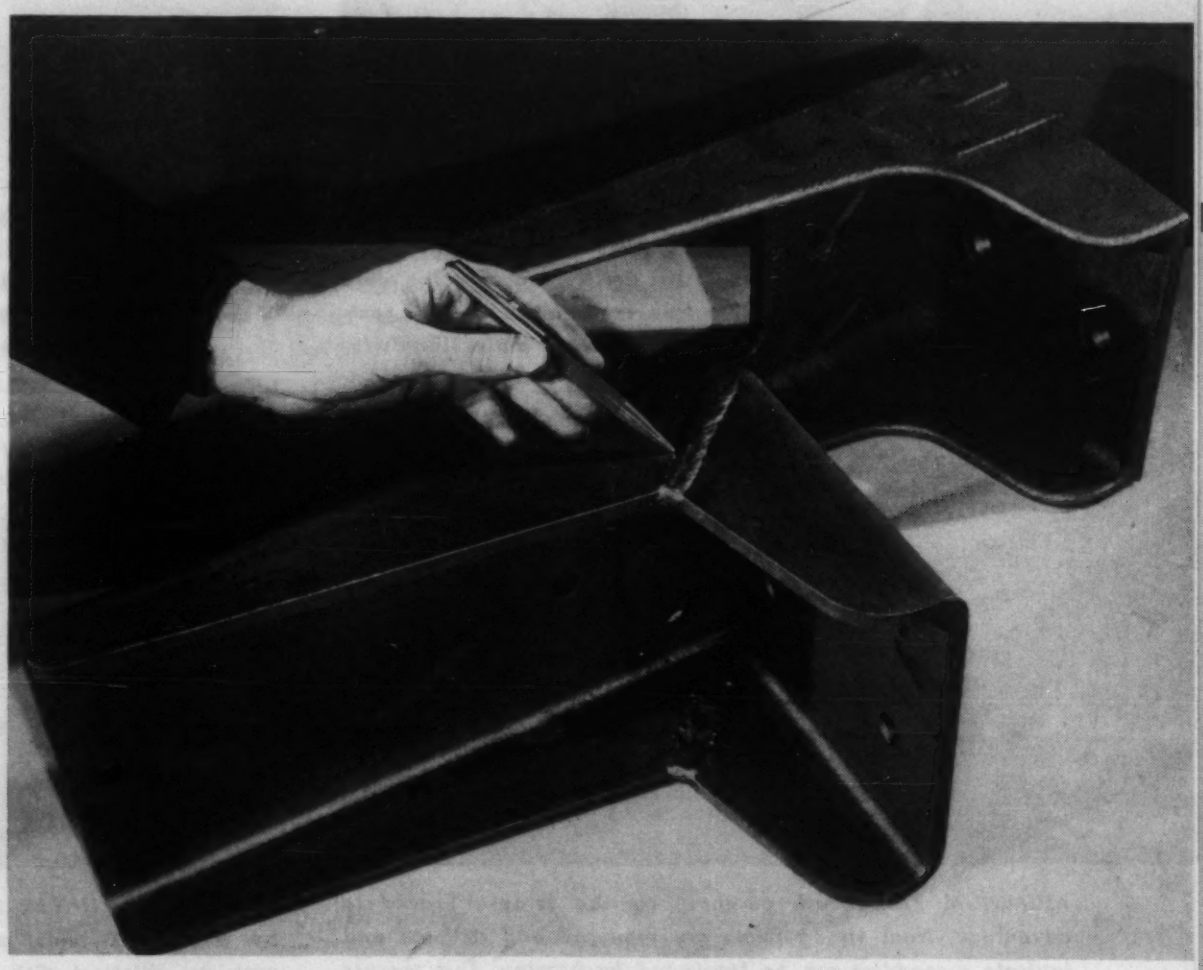
Ductility is closely tied in with impact strength. Where proper welding procedures and/or post heat treatments are used, welds can be expected to have satisfactory impact strength. However, in general, it will not be as good as that of the base metal. It has been found that a considerable portion of the energy of impact may be absorbed by the metal adjacent to the weld.

In applications involving dynamic loading or repeated stresses, fatigue strength becomes an important consideration. In general, it has been found that the fatigue strength of machined and sound butt welds is about the same as base metal of the same tensile strength, at least up to about 80,000 psi. Because of the unavoidable notch effects in fillet welds, they have only about 50 to 70% the fatigue strength of butt welds of equivalent static strength.

Resistance Welds—The strength properties depend on the pre-weld strength or temper and composition of the unwelded base metal. Where the quenched metal responds to tempering, the weld properties also respond in the same way. Parts using spot and projection welds are usually designed so that the welds are loaded in shear when the parts are stressed in tension or compression. Resistance welded joints in the common metals, stressed in this way, will provide the full tensile strength of a strip of the base metal for a width somewhat greater than the weld diameter.

Direct tensile strength of spot and projection welds is about 25 to 40% of the strength in shear for ductile welds and considerably less in non-heat treated welds in hardenable metals.

With flash welding, welds equal in strength to the base metal can be obtained, provided the joint is properly designed and the weld is metallurgically sound.



Redesign of this simple bracket to take full advantage of economies afforded by welding reduced cost 67%. (General Electric Co.)

Brazing—Brazing is suitable for joints subjected to a moderate amount of stress. Usually shear strengths of brazed joints rather than filler metal strength is most important. The joint strength depends on a number of factors, including strength of the members being joined, thickness of filler metal layer, or "clearance", and type of joint. In the case of lap joints, the strength can be controlled by varying the length of the lap. In general, a lap length three times the thickness will provide joint strengths equal to that of the base metal.

Maximum bond strength is generally obtained with joint spacings or clearance of 0.001 to 0.006 in., varying with the filler metal used. Shear strengths based on silver-brazed low carbon steel joints range from around 30,000 to 40,000 psi. Copper brazed joints range from around 20,000 to 30,000 psi.

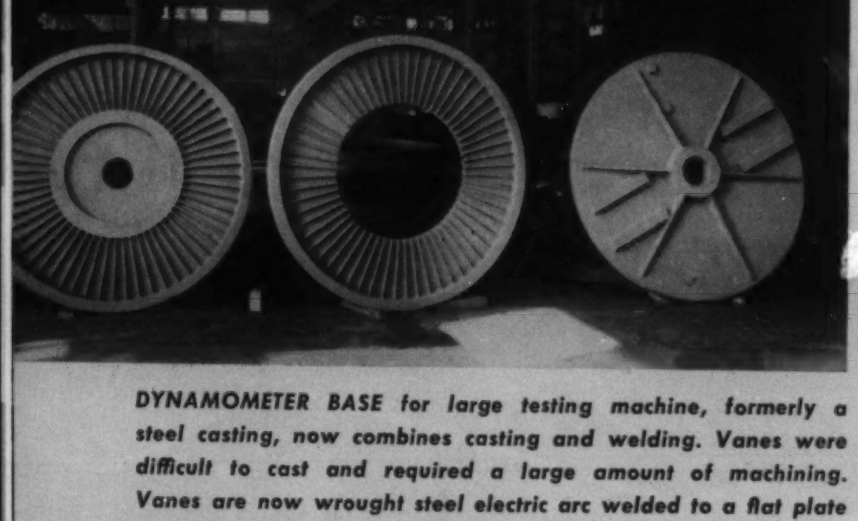
Since brazing alloys have relatively low melting points, their short time tensile strength is about one-half the room temperature strength at 500 F.

Impact strength is largely determined by the materials being joined and the design. Fatigue strength of silver brazed joints is of the same order of magnitude as the materials being joined up to about 27,000 psi. Where materials stronger than this are involved, the higher fatigue strengths cannot be realized unless the design is such that the fatiguing stress in the brazing layer does not exceed 27,000 psi figure.

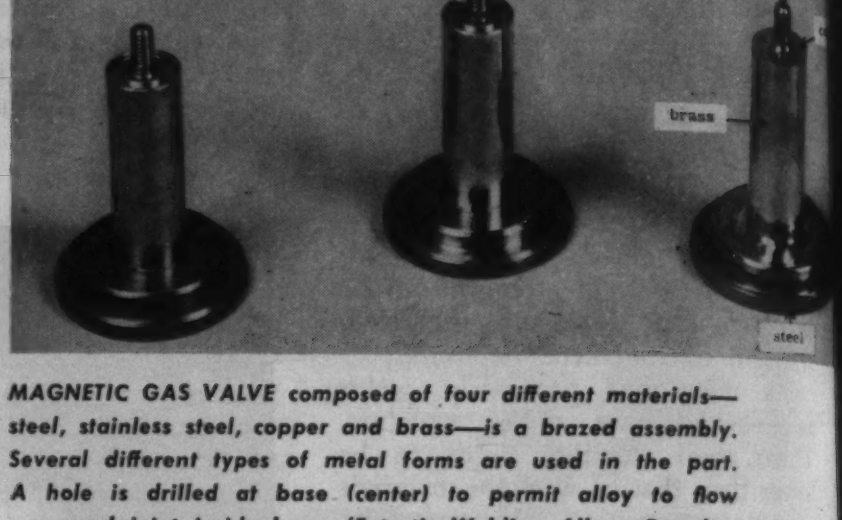
Corrosion Resistance

If the weld metal is the same or nearly the same composition as the base metal, the corrosion resistance will generally be about the same as that of the base metal. This is particularly true if the weldment is

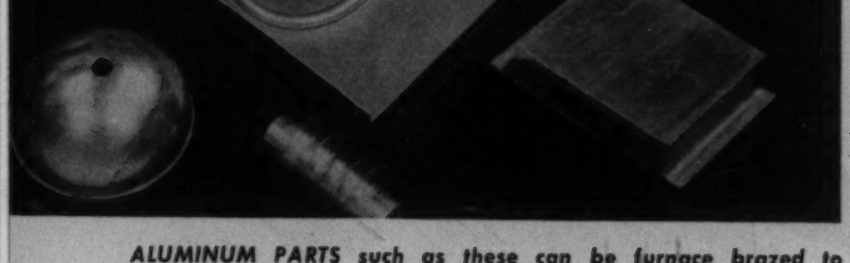
TYPICAL APPLICATIONS



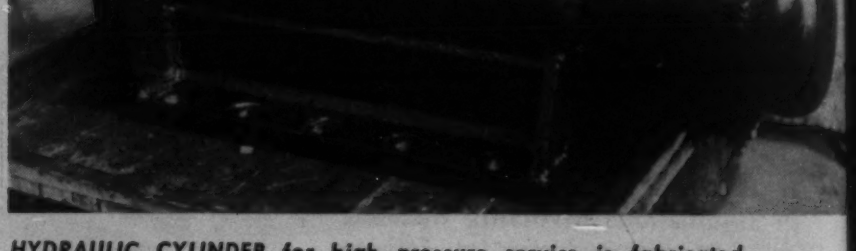
DYNAMOMETER BASE for large testing machine, formerly a steel casting, now combines casting and welding. Vanes were difficult to cast and required a large amount of machining. Vanes are now wrought steel electric arc welded to a flat plate backing and formed steel ring. Hub in center is a steel casting. Bars on back are welded to flat steel plate. (Baldwin-Lima-Hamilton Corp.)



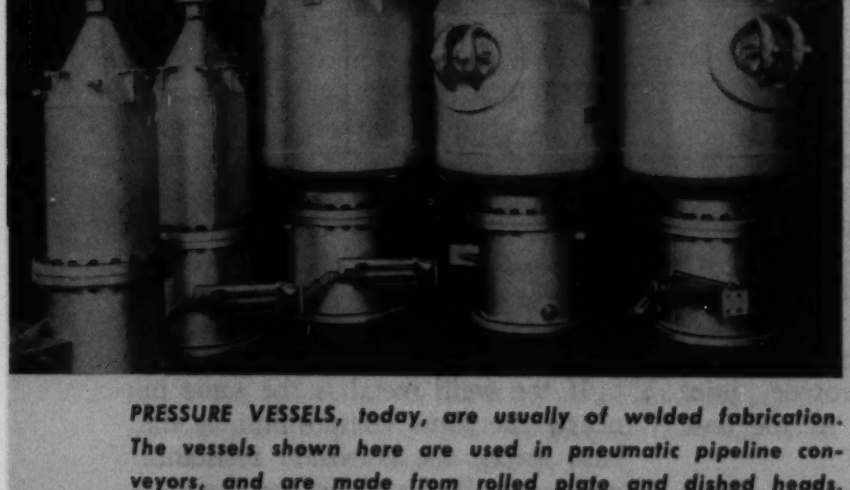
MAGNETIC GAS VALVE composed of four different materials—steel, stainless steel, copper and brass—is a brazed assembly. Several different types of metal forms are used in the part. A hole is drilled at base (center) to permit alloy to flow around joint inside base. (Eutectic Welding Alloys Corp.)



ALUMINUM PARTS such as these can be furnace brazed to advantage. Neat strong joints are produced and delicate and intricate assemblies can be fabricated by brazing. This process makes possible low-cost batch brazing of aluminum and aluminum alloy parts, and provides neat joints that require less finishing. (Aluminum Co. of America)



HYDRAULIC CYLINDER for high pressure service is fabricated by welding. Cylinder proper is heavy wall seamless tubing with an elliptical dished head at the rear, and heavy front plate and mounting legs for a stationary cylinder. (Struthers Wells Corp.)



PRESSURE VESSELS, today, are usually of welded fabrication. The vessels shown here are used in pneumatic pipeline conveyors, and are made from rolled plate and dished heads. The smaller size contains 18 pieces besides miscellaneous caps, bolts and nuts. The swing gate valve bolted to the vessel contains 33 pieces, exclusive of miscellaneous fittings and fasteners. (R. C. Mahon Co.)

FRONT AXLE SUPPORT for tractor made by both spot and projection welding of thick sheet stampings. It was previously made as a riveted assembly and as a malleable iron casting. The resistance-welded part is stronger and is considerably less costly than either. (General Electric Co.)

annealed or is solid-solution heat treated after welding. However, if the weld metal differs chemically or metallurgically from the base metal, corrosion may occur at the weld or adjacent to it. Weld imperfections may also serve as a starting point for corrosion. Other factors influencing the corrosion resistance of welds are the joint design, welding process, flux removal and stress corrosion.

Following is a brief summary of the corrosion resistance characteristics of welds in the common engineering metals. Most of these data were taken from the "Welding Handbook" of the American Welding Society.

Irons and Steels—Arc welds made with covered electrodes and gas welds in mild steel have about the same corrosion resistance as the base metal in a variety of media. Galvanic corrosion must be guarded against in cast iron welds. Good results have been obtained with alloy cast iron and high nickel alloy rods. Submerged arc welds have corrosion resistance similar to the base metal. Flash and spot welds also have satisfactory corrosion resistance. Arc or gas welds in low-alloy steels made with low-alloy filler metal have corrosion resistance similar to the base metal.

Stainless Steels—Arc and gas welds with corrosion resistance about equal that of the base metal can be obtained by proper techniques and filler metal selection. Corrosion resistance is adversely affected in unstabilized grades if carbon content is over about 0.03%. In any case, carbon content should be maintained under 0.08% in both the weld and base metals.

Nickel Alloys—Welds having satisfactory corrosion resistance can be made by gas, arc and resistance welding methods. Filler metals should have about the same composition as base metal.

Aluminum and Its Alloys—Corrosion resistance of 2S, 3S, 4S, 52S, 53S, 61S, 63S, R353, R361 and cast alloys 43 and 356 is not reduced by welding. Corrosion resistance of aluminum-copper alloys are usually lowered.

Magnesium and Its Alloys—Under normal conditions of exposure, welded joints have similar corrosion resistance to base metal, when welded by inert-gas arc process. Spot welded joints also have similar corrosion resistance, provided copper pickup is avoided. Gas welding and brazing require thorough flux removal to avoid corrosion.

Copper and Its Alloys—Gas welding of copper using deoxidized copper rod produces welds of satisfactory corrosion resistance. Use of high zinc brasses may lead to corrosion difficulties. Common brasses and phosphor bronzes are gas welded or brazed with high zinc filler metal where corrosive conditions are mild. For more severe conditions, silicon bronzes welded with filler metal of same composition provides corrosion resistance equal to that of the base metal.

Surface Appearance of Welds

The weld geometry and surface appearance of welded joints varies considerably, depending principally on the process and joint design. Gas and arc welded butt joints are, in effect, a continuation of the stock being joined. In the as-welded condition, the weld usually has a ridge of reinforcement metal on one or both sides. In general, manual arc welds will have a rippled surface whereas gas welds will present a smoother appearance. The surface of inert-gas arc welds in some metals is clean and bright. Submerged arc welds usually have a smooth surface. Good fillet welds have a triangular profile with a flat or slightly concave surface. On lap joints, the weld is also triangular in profile.

Where the reinforcement on butt welds is undesirable, it can be ground, chipped or machined off. If completely and cleanly removed, no evidence of the weld will remain. With some of the arc welding processes, weld metal is spattered on adjacent metal. This can be removed, if excessive or objectionable, by grinding, grit blasting, wire brushing or scrapping.

Surfaces of spot and seam welded parts are always indented or marked to some extent on at least one side. It is usually possible to make welds without such surface markings on one side by using a flat electrode on that surface. A concave electrode is sometimes used on thin parts and the resulting raised surface ground flush. The surfaces of coated metals are usually at least partially destroyed at and in the vicinity of the resistance welds. This must be taken into account where service conditions require an undamaged coated surface.

Butt-flash welds have a flashing of extruded metal around the outside of the joint which is trimmed off after welding where appearance and/or fatigue strength demands it.

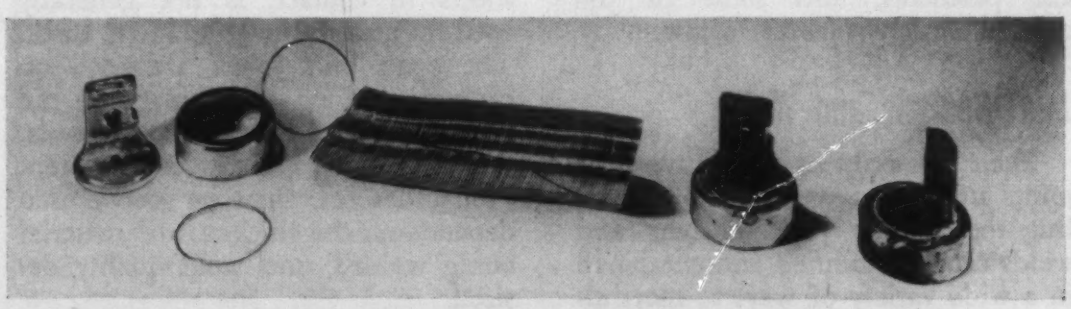
Brazed joints usually are made with a close fit-up and the joint, therefore, consists of only a thin weld line. In certain applications where the brazed joint must be of the same color, a color match is obtained by proper selection of the brazing alloy.

Machinability

Since hardness and metallurgical structure of a weld usually differs from the base metal, the machinability will also differ. In some cases the difference is not great enough to cause any difficulties while in others the hardness of the weld can make machining impracticable. Whereas the welds in low-carbon steels, either in the as-welded or stress-relieved condition, are readily machined, preheating and postheating are necessary to improve the machinability of welds in higher carbon steels and alloys.

For medium carbon and low alloy steels, a preheat, a high welding heat input by use of large electrodes, and a slow travel rate of the electrode will reduce the as-welded hardness by reducing the cooling rate of the weld and adjacent metal.

In planning a weldment, the machining properties of the base metal are generally more important than those of the weld. Where other selection factors permit, a filler metal should be chosen, which, when deposited, will most nearly match the base metal hardness, after heat treatment. In cases where machining difficulties cannot be eliminated, it may



Parts are readily assembled by brazing using preforms. (Handy & Harman)

be possible to redesign so that the weld joint will not be located in the surface to be finish machined.

Physical Properties

Very little information is available on the electrical, thermal and other physical properties of welded joints. The reasons for this may be that in most applications these properties closely match those of the base metal or they are not of critical importance in the service performance of the weldment.

In general, the thermal properties, such as thermal conductivity and coefficient of expansion, of a welded joint are the same as those of the base metal when the composition of the deposited weld metal and metals being joined are the same. Likewise, magnetic properties of the welded joint and base metals will closely match if their compositions are the same.

Electrical conductivity or resistivity are important properties to consider in many electrical applications. In these cases, the filler metal must be carefully selected with these characteristics in mind.

Thermal and Mechanical Treatments

There are a number of different preweld or postweld treatments that can be applied to weldments to change the properties of welded joints either for fabrication purposes or to improve their service performance. The majority of welded parts do not require such treatments. But there are a number of fields of application, particularly if the weldment will be subject to relatively high service stresses, where certain thermal or mechanical treatments are believed necessary or where various construction codes make such treatments mandatory.

Preheat—Preheating consists of heating the weldment or area to be welded up to around 400 or 500 F before welding. It is generally used in gas welding heavy (½ in. and above) sections of most metals. In metal-arc welding of steel, it reduces rate of cooling after welding and thus gives lower hardness and a wider heat affected zone.

Thermal Stress Relief—This treatment is applied after welding for the purpose of relieving internal stresses set-up during welding. The weldment is heated up to a temperature of 1000 to 1400 F, depending on the metal, and held for several hours, depending on the metal and thickness. It is then slowly cooled.

Low Temperature Stress Relief—This method is used for reducing residual stresses in welded structures that are too large to be placed in a furnace. It involves progressively heating two bands, one on each side of the welded joint, while keeping the joint itself relatively cool.

Normalizing—This treatment is used to refine the grain size after hot working operations. Where needed to provide the required properties in the material forms making up the weldment, it is generally done prior to the welding. Normalizing is sometimes performed after welding; for example, to improve impact strength at subzero temperatures in low alloy materials containing nickel, copper-chromium-nickel or aluminum-killed carbon steel.

Full Annealing—Full annealing is similar to normalizing in action except that larger grain size results. Annealing following welding is common for air hardening materials.

Quenching and Tempering is sometimes employed to provide required hardness in either the weld metal or base metal.

Solution and Precipitation Treatments—These treatments are applied to develop aged properties in certain alloys, including aluminum and some of the low alloy steels.

Peening—The main purpose of peening is to reduce stresses in welded joints. It is performed by hand with a hammer, or with air hammers, or with mechanically operated trip hammers.

Proofstressing — Pressure vessels are readily proof stressed by hydrostatic loading. Proofstressing of weldments of more complex geometry presents difficulties. The purpose of this treatment is to decrease locked-up stresses.

Design Considerations

Although it is beyond the scope of this Manual to cover design details, it is important for the engineer who is contemplating the use of welding to have a general idea about the basic types of welded joints, the tolerances that can be generally met, distortion and shrinkage problems, and some of the general design rules to follow.

Joint Designs and Welds

There are only five basic types of joints and even fewer types of welds. But these basic joint designs and welds can be modified and combined in a wide variety of ways to meet almost any joint requirement. Sketches of the basic joint designs and types of welds are shown with the accompanying table, which shows the joint types applicable to the various welding processes and to thick and thin sections of material.

Butt joints can be either closed or open. The closed butt joint, with sheets in contact, is not generally used on material over 1/16 in. thick. The open butt joints are used on material heavier than this. They can be designed with or without grooves. There are a variety of different groove designs; the type groove used depends on the thickness of material being welded, and weld quality desired.

"T" joints are either open or closed, and one member may or may not be beveled. In any case, to obtain maximum strength, the joint should be welded on both sides of the vertical plate. "T" joints are applicable to all thicknesses.

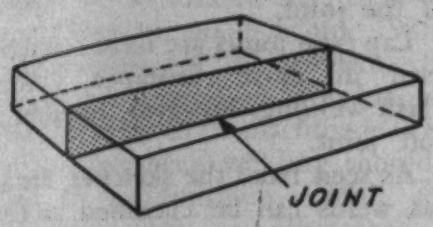
Corner or "L" joints are similar to "T" joints except that one member does not extend beyond the other. The joint can be welded on just the outside or on both sides, depending on the thickness and strength requirements.

Edge of flange joints are used on thin sections (usually not over ¼ in.) whose surfaces are together with their edges in line. They are not recommended for heavy loads.

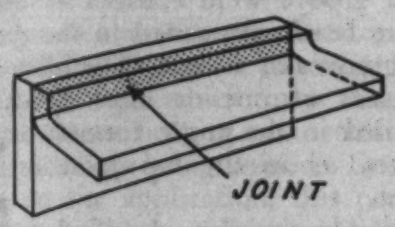
Lap joints require no beveling

TYPES OF JOINTS AND WELDS

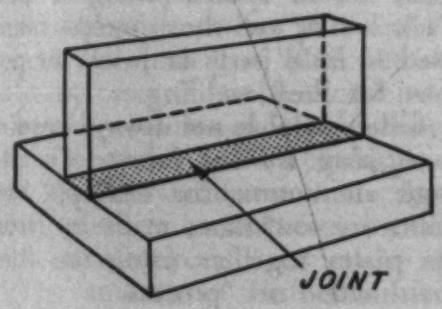
Basic Joint Designs



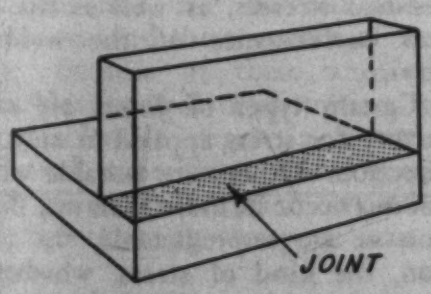
BUTT WELD



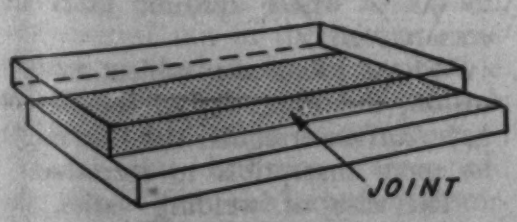
EDGE JOINT



TEE JOINT

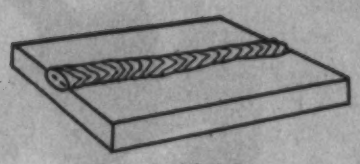


CORNER JOINT

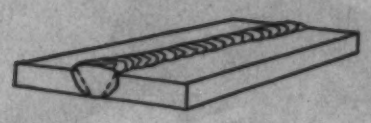


LAP JOINT

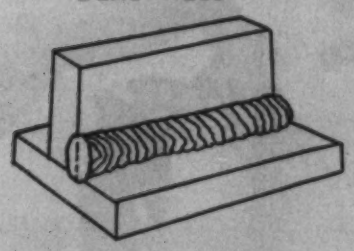
Basic Weld Types



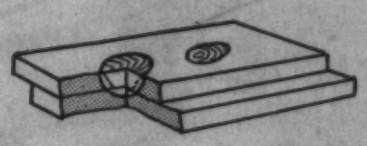
BEAD WELD



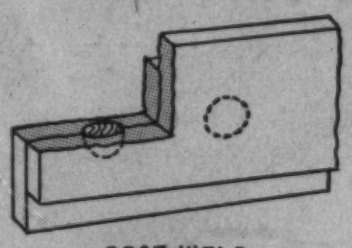
GROOVE WELD



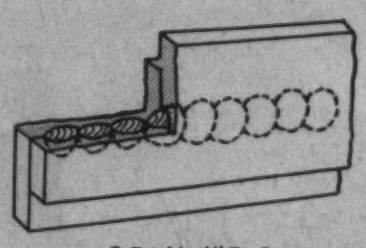
FILLET WELD



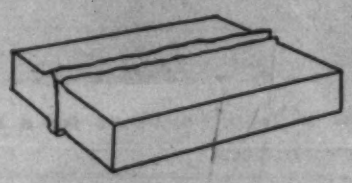
PLUG WELD



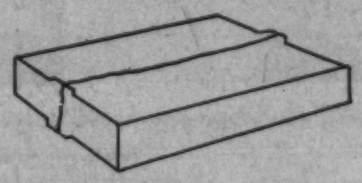
SPOT WELD



SEAM WELD



FLASH WELD



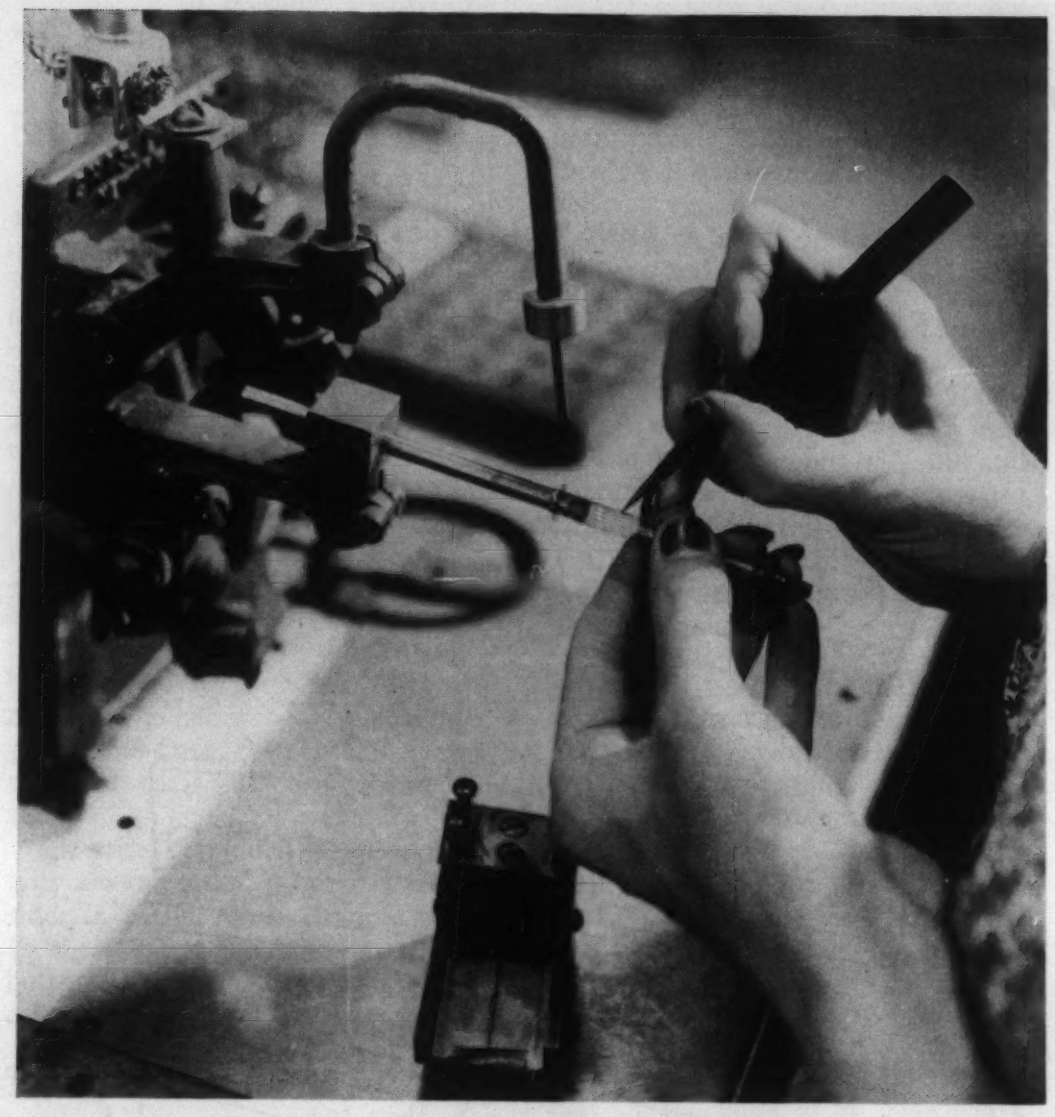
UPSET WELD

Joint Design for Various Welding Methods

Welding Process	Butt Joint		Lap Joint		Fillet Joint		Edge Joint	
	Light Sect.	Heavy Sect.	Light Sect.	Heavy Sect.	Light Sect.	Heavy Sect.	Light Sect.	Heavy Sect.
Shielded Metal-Arc(Coated Electrode)	S	R	R	R	R	R	NR	R
Submerged-Arc	S	R	S	R	S	R	NR	S
Atomic Hydrogen	R	S	S	S	S	R	R	S
Inert Gas Tungsten-Arc	R	S	R	S	R	S	R	S
Inert Gas Metal-Arc	NR	R	NR	R	NR	R	NR	S
Flash Welding	NR	R	NA	NA	NA	NR	NA	NA
Spot Welding	NA	NA	R	R	NA	NA	NA	NA
Seam Welding	NA	NA	R	R	NA	NA	R	R
Gas Welding (Oxy-Acetylene)	R	S	R	S	R	S	R	S
Brazing—Furnace	NR	NR	R	R	R	R	NA	NA
Brazing—Torch	S	S	R	R	R	R	S	S

R —Recommended
S —Satisfactory
NR—Not Recommended
NA—Not Applicable
Light Section: 0.005 to 0.125 in.
Heavy Section: ⅛ in. and over

Adapted from "Factors in Selection of Welding Processes" by John J. Chyle, a paper presented at SAE Summer Meeting, June 1–6, 1952.



Spot welding tantalum grid wires (0.007-in. dia) to tantalum sleeve for a transmitting tube at Amprex Electronic Corp.

and, therefore, are economical to prepare. However, in arc and gas welding applications they are not as suitable as butt joints for heavy loads, nor can they be used where double thicknesses are objectionable.

Basic joints for brazed parts are the lap and butt types as well as the scarf joint, which is a modification of the butt joint. There are many variations of these basic types, an important one being the sleeve joint used widely for tubular parts and fittings. Regardless of joint design, it is important that joint clearances be held to a few thousands of an inch so that the brazing alloy can flow by capillary action to all parts of the joint.

Lap type joints are most commonly used in most resistance welding. Flash welding, however, requires the butt joint.

As seen from the sketches, arc and gas welds can be classified as bead, groove, fillet or plug. The bead weld is a single pass of weld metal on the surface and is used in metal surfacing or in welding a closed butt joint. The groove weld consists of one or more beads, deposited in the groove or grooves of a joint. The fillet weld consists of one or more beads deposited in the angle formed by two plates, as in the lap joint or "T" joint.

Welds are also classified as continuous, intermittent and tack. A continuous weld is one that extends from one end of a joint to the other. An intermittent weld is a series of short welds spaced along a joint. Tack welds are short welds merely used to hold parts or joints in position for final welding.

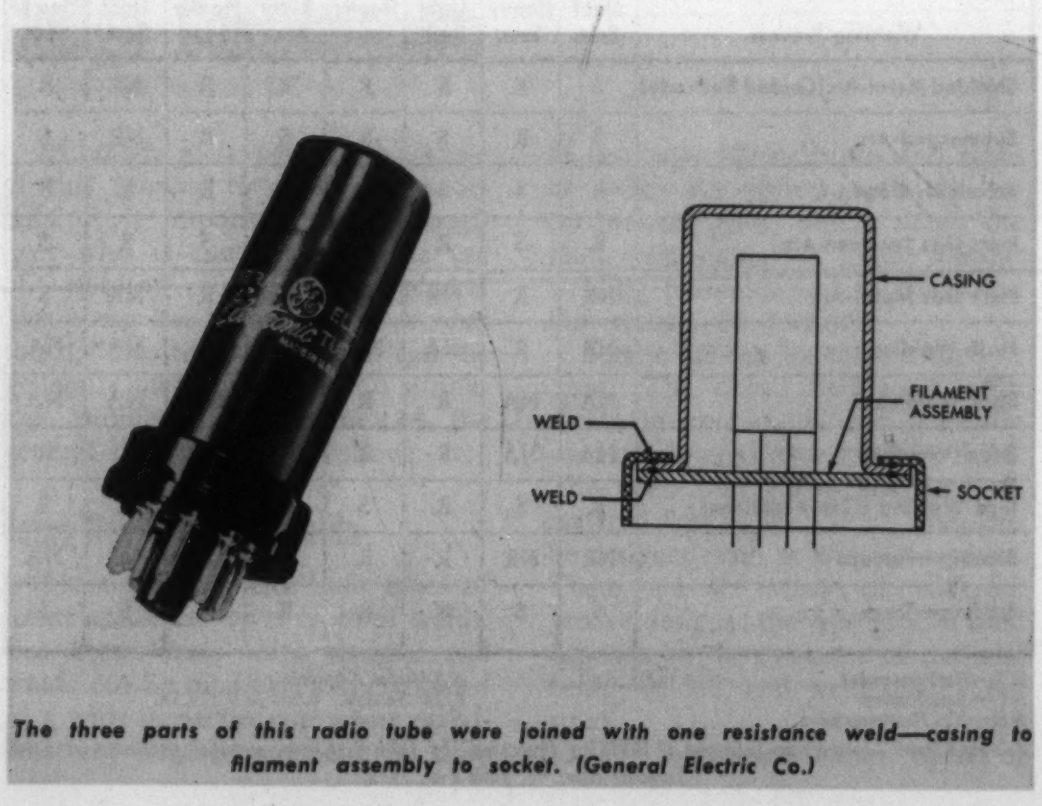
Filler metal is not always required in making welded joints. On thin gage aluminum, for example, butt joints are sometimes made by fusing the plates together using the inert-gas-shielded arc process.

The selection of the proper joint design and its location is of considerable importance because it influences the amount of distortion and residual stresses, as well as the cost and performance of the weld in service.

Certain types of joints are satisfactory for stress applied in only one direction. Others are suitable where stresses occur in more than one direction or are unpredictable. In addition, the kind of stress, whether it is tension, shear, bending, torsion, or a combination of these, must be considered. Also, different joint designs may be required in applications where loading is static as compared to others where dynamic loads are encountered.

Where joints are subject to corrosion, the joint design should not have surface irregularities that might be more susceptible to corrosion.

The ease of welding varies, depending on joint design. For ex-



The three parts of this radio tube were joined with one resistance weld—casing to filament assembly to socket. (General Electric Co.)

ample, edge welds and corner welds are usually easiest to make and can be welded at higher speeds than any other type of joint. The location of the joint is equally important. Joints should be easily accessible for welding and inspection, and placed for maximum speed of welding. They should be so located that they lend themselves to good fit-up. Where machinability is a problem, they should be located, if possible, outside the areas to be machined. Vertical and overhead welding should be held to a minimum. With some processes, such as submerged arc welding, the joints must be in a flat or almost horizontal position.

Residual Stresses and Distortion

One of the inherent characteristics of welding is that it produces localized heating, which may result in nonuniform heating and cooling in the members being joined. Depending on the application, this presents certain problems, which require consideration when planning to use welding in the production of a part.

One possible result of localized heating is distortion during fabrication. The importance of this distortion depends on the part and the service to which it is to be put. But in most cases it is objectionable, for it usually requires expensive straightening operations. Therefore, design and the fabrication methods should be planned so as to keep distortion to a minimum.

The amount of distortion developed in any case depends on many factors, among which are the size and type of welds, their distance from the neutral axis, the welding method used, the material and its thickness, and the sequence of welding. Because of these and other variables, control of distortion is to a considerable degree a matter of practical experience. Consequently, only general information on methods of counteracting warpage can be given.

Since distortion is a result of welding, the amount of welding should be kept to a minimum consistent with the service requirements to be met. Joints should be planned so that welding on both sides, or around, the neutral axis of the part or structure is as nearly balanced as possible. The sequence of welding if properly planned can often distribute and balance the distorting forces and stresses. Often the expected distortion can be compensated for by forming the part out of shape in such a way that the heat of welding pulls it into the desired shape.

For some metals, such as copper, another method is to stretch the weld metal immediately after being deposited by hammer blows or peening. Proper use of tack welds to hold the assembly in position during welding and good fit-up are other ways of minimizing distortion.

Another possible result of localized heating from welding is the development of residual or locked-up stresses. Whether or not residual stresses are harmful in welded structures is a controversial subject about which there is considerable difference of opinion. In any case, there are many products where these stresses have little effect on service performance. In other applications, however, because of the nature of the design and the service loading the residual stresses may be significant. Some authorities believe that if a welded structure is loaded, for example, in the same direction as the residual stresses, the combination of stresses may exceed the strength of the material and cause failure. Residual stresses can also cause warpage or distortion during machining operations, or cause creepage of the welded part over a period of several years in service.

Inert-gas-shielded arc welding a magnesium side frame for passenger seat. (Linde Air Products Co.)

The residual stresses are almost always greatest in the longitudinal direction of the weld and will usually be at least equal to the yield point on welds over 18 in. in length that have wide bands of relatively low residual compression stresses on each side of the weld.

While there is difference of opinion as to whether or not residual stresses do affect the service performance of welded parts, the practice is to reduce residual stresses by a planned welding procedure, stress-relief treatment or mechanical means in those cases where codes or service requirements demand it.

Tolerances

Little specific information is available on just what tolerances can be met in welded parts. The two principal factors influencing tolerances are distortion from the welding operation and the tolerances of the metal forms that make up the weldment. The tolerances on the various metal forms, such as flat stock, castings, forgings and rolled sections, are easily obtainable. But as already mentioned, the degree of distortion is a function of a great many things, and, therefore, exact values cannot be given.

However, from the experience gained over many years of arc and gas welding machinery weldments, the following tolerances seem to be those most commonly achieved in this type of structure. (From "The Welding Handbook").

1. Small parts containing very little welding, 1/8 in.
2. Moderately large parts containing a small amount of welding, 1/4 in.
3. Large structures containing moderate amounts of welding, 3/8 in.
4. Large complicated structures and structures containing large amounts of welding, 3/8 to 1/2 in.

Cost of Welding

One of the primary factors when considering any means of fabrication is cost. Welded fabrication is no exception.

The total cost of producing a welded or brazed part, aside from overhead and equipment costs, is made up of the following items:

1. Material cost. This includes the cost of the metal forms or components making up the weldment; for example, the plate or sheet, the castings, stampings or extrusions. If a component such as a plate or tubing must be shaped before welding, the cost of such forming operations must also be included.
2. Preparation cost. This includes the cost of preparing for welding, such as scarfing or removing scale, grease or other foreign material from the surface.
3. Set-up Cost. This includes such things as assembling of the part in jigs and fixtures, tack welding, proper positioning, and preheating prior to welding.
4. Welding Cost. This includes the cost of the filler metal, labor and electric power, gases or other heat sources for welding.
5. Finishing Cost. This includes the cost of removing excess weld metal, and weld spatter, heat treatment and/or stress relieving after welding, machining and applying final finishes or coatings to the part.

Whether a welded or brazed part can be made cheaper than by some other method depends upon how the cost of all the above items—not only the cost of the welding operation—compares with the cost of all the operations in the other possible methods.

It is extremely difficult and frequently inaccurate to make general cost comparison between various fabrication methods. Each application must be analyzed separately for a true comparison.

There are a number of general rules which, if followed when planning a weldment, will help produce economical weldments.

1. Keep the amount of welding to a minimum. Weld metal is expensive, and all other factors being equal, the design requiring the least amount of filler metal is the most economical. Locating the welded joints in the thinner sections and use of rolled, formed or cast shapes instead of built-up assemblies are two common means of holding amount of weld metal to a minimum. Other ways are by use of narrow welding grooves and small continuous fillet welds instead of larger intermittent welds.
2. Locate welds in the most accessible locations and in the most favorable position for fit-up, welding, cleaning and inspection. In general, horizontal welds can be made more cheaply than vertical welds, and welds in the flat position are cheaper than horizontal welds.
3. Only the minimum material necessary to meet service requirements should be used. Through careful planning, the raw material should be used most effectively, keeping scrap to a minimum.
4. When a welding is decided upon as the method of fabrication, the part should be designed specifically as a weldment. Only in this way can the full economic benefits of welding be realized.

The above ways of lowering costs are confined to the actual planning and designing of weldments. In addition, savings can be realized in the actual production of the weldment by such methods as using setting-up fixtures and positioning fixtures. selecting the most economical size and type of filler metal, and avoiding the common practice of overwelding.

References

"Welding Handbook," Third Edition. Published by American Welding Society
"Modern Arc Welding." Published by Hobart Brothers Co.
"Procedure Handbook of Arc Welding Design and Practice," Ninth Edition. Published by Lincoln Electric Co.

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General Electric Co.
Graver Tank & Mfg. Co., Inc.
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Hobart Brothers Co.
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November • 1952
Number 238

Bending of Aluminum Alloy Sheet

Many fabricating operations involve the bending of sheet material to form the desired part. In such work, consideration must be given to the sharpness of the bend since the ductility varies with the alloy. Bends which can be made satisfactorily with one composition may be too drastic for another and cracking will result.

The minimum allowable radii for bending aluminum alloy sheet depends on the thickness, temper and composition of the material. Values given in the table are for 90-deg bends. For bends greater than 90 deg, the bend radii should be increased.

Gage	75S-O **75S-W	75S-T6	24S-O *24S-W R301-O 14S-O	R301-T3 or 14S-T3	24S-T3 R301-T6 or 14S-T6	61S-O	61S-T4	61S-T6
0.020	1/32	3/32	1/64	1/16	1/16	0	1/32	1/32
0.025	1/32	1/8	1/64	1/16	3/32	0	1/32	1/32
0.032	1/16	5/32	1/64	1/16	3/32	0	1/32	1/32
0.040	1/16	3/16	1/32	3/32	1/8	0	1/32	1/32
0.051	3/32	1/4	1/16	1/8	3/16	0	1/16	1/16
0.064	1/8	5/16	1/16	5/32	7/32	0	1/16	3/32
0.081	5/32	3/8	3/32	7/32	9/32	0	3/32	1/8
0.091	3/16	1/2	3/32	1/4	11/32	0	1/8	5/32
0.102	3/16	5/8	3/32	5/16	7/16	0	1/8	3/16
0.125	7/32	3/4	1/8	3/8	1/2	1/16	3/16	1/4
0.156	3/8	1	5/32	7/16	5/8	1/8	5/16	5/16
0.187	1/2	1 1/4	3/16	1/2	3/4	3/16	3/8	9/16

* *(24S-W) Freshly quenched and formed within 1/2 hr max or 24 hr max if iceboxed at 32 F.*
** *(75S-W) Freshly quenched and formed within 2 hr max or 24 hr max if iceboxed at 32 F.*

Gage	52S-O	52S-H32 ¼ Hard	52S-H34 ½ Hard	52S-H38 ¾ Hard	52S-H38 Hard	2S-H12 ¼ Hard	2S-H14 ½ Hard	2S-H16 ¾ Hard	2S-H18 Hard
0.020	0	0	0	1/32	1/32	0	0	0	1/32
0.025	0	0	0	1/32	1/32	0	0	0	1/32
0.032	0	0	0	1/32	1/16	0	0	0	1/32
0.040	0	0	0	1/16	1/16	0	0	0	1/16
0.051	0	0	1/32	1/16	3/32	0	0	1/32	1/16
0.064	0	0	1/16	3/32	1/8	0	0	1/16	3/32
0.081	0	1/32	1/16	1/8	3/16	1/32	1/32	1/16	1/8
0.091	0	1/16	3/32	1/8	1/4	1/16	1/16	3/32	1/8
0.102	0	3/32	1/8	3/16	5/16	3/32	3/32	1/8	3/16
0.125	0	1/8	1/8	1/4	3/8	1/8	1/8	1/8	1/4
0.156	0	5/32	3/16	1/2	5/8	5/32	5/32	3/16	1/2
0.187	0	3/16	9/32	9/16	3/4	3/16	3/16	9/32	9/16

From "Design Manual for the Repair of Aluminum Structures," by Howard M. Jensen.
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take a

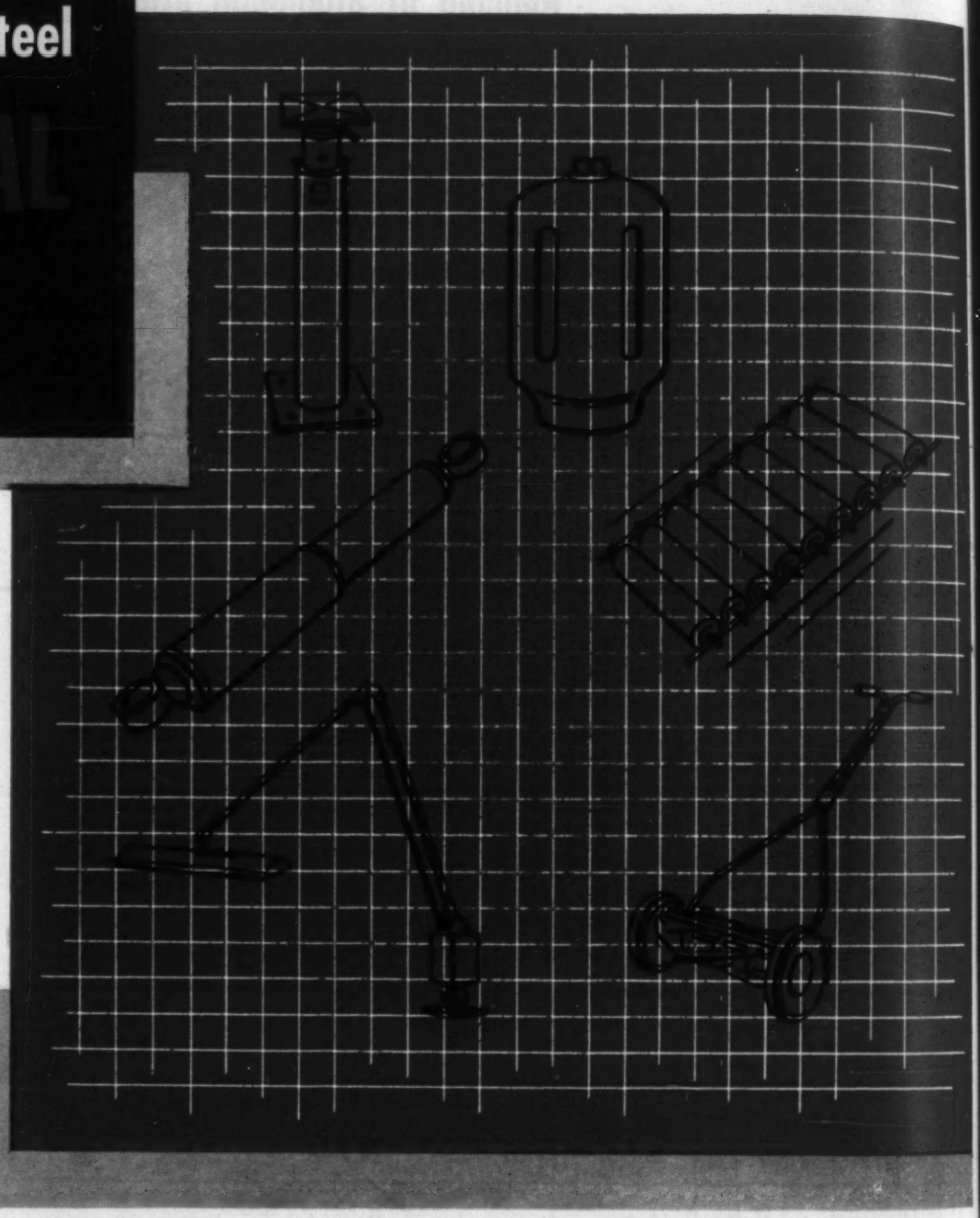
CLOSER LOOK

at

B&W ERW Carbon Steel

MECHANICAL TUBING

to



. . . Simplify Product Design

. . . Improve Appearance

. . . Reduce Scrap Loss

. . . Speed Fabrication

. . . Save Final Finishing Time

. . . Secure Maximum Economies

. . . Obtain Higher Strength to Weight Ratio

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Beaver Falls, Pa.—Seamless Tubing; Welded Stainless Steel Tubing
Alliance, Ohio—Welded Carbon Steel Tubing

Sales Offices: Beaver Falls, Pa. • Boston 16, Mass. • Chicago 3, Ill. • Cleveland 14, Ohio • Denver 1, Colo. • Detroit 26, Mich. • Houston 19, Texas • Los Angeles 17, Cal. • New York 16, N. Y. • Philadelphia 2, Pa. • St. Louis 1, Mo. • San Francisco 3, Cal. • Syracuse 2, N. Y. • Toronto, Ontario • Tulsa 3, Okla.

TA-1689M

Materials Engineering File Facts

MATERIALS & METHODS
November • 1952
Number 239

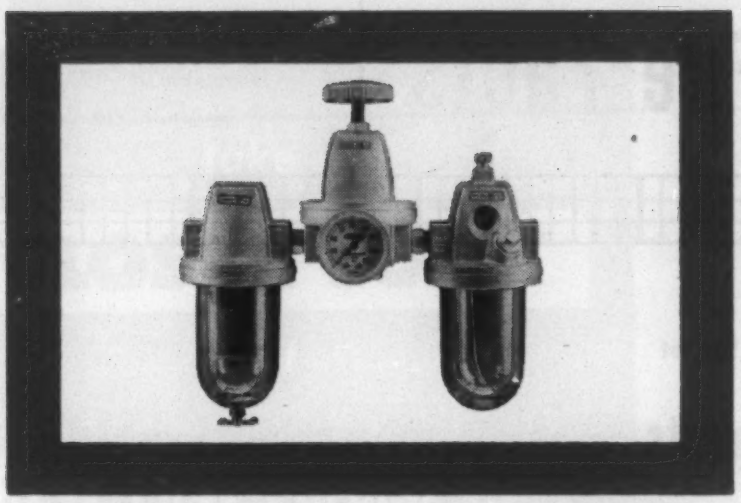
Materials Data Sheet

Lead-Base Babbits

The lead-base babbits are used in applications where anti-seizing characteristics, deformability and corrosion resistance are required. Frequently regarded as low-cost substitutes for the tin-base babbits, it has been determined that, when used in thin bearings of the order of 0.030 in. or less, they have fatigue characteristics equal to those of the tin alloys.

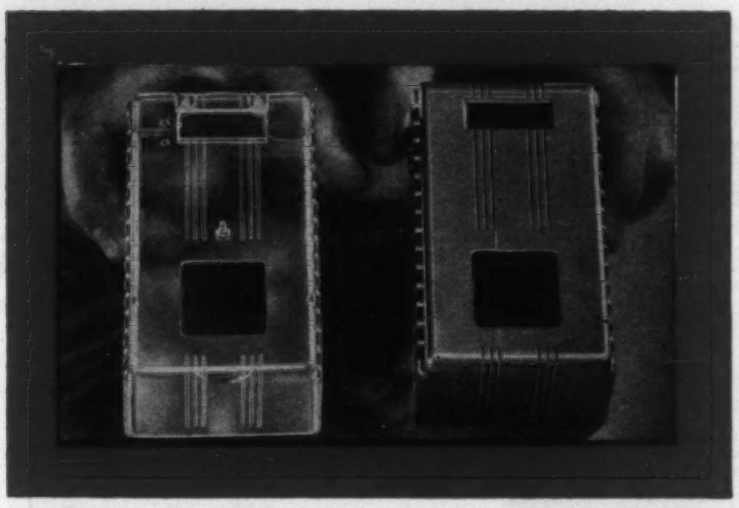
Type / ASTM Grade	6	7	8	10	11
COMPOSITION, %	Sn 20 Sb 15 Pb 63.5 Cu 1.5	Sn 10 Sb 15 Pb 75 —	Sn 5 Sb 15 Pb 80 —	Sn 2 Sb 15 Pb 83 —	— Sb 15 Pb 85 —
PHYSICAL PROPERTIES					
Density, Lb/Cu In.	0.336	0.350	0.361	0.362	0.370
Melting Range, F	531–358	514–464	522–459	507–468	504–471
Thermal Cond, Btu/Hr/Sq Ft/Ft/F, @ 212 F	—	14	14	—	—
Coeff of Exp per F:					
68–212 F	—	10.9×10^{-6}	13×10^{-6}	—	—
Spec Ht, Btu/Lb/F:	—	0.065	0.065	—	—
Elect Res, Microhm-Cm @ 68 F	—	28.6	28.2	—	—
MECHANICAL PROPERTIES					
Mod of Elast in Tension, Psi	—	4.2×10^6	4.2×10^6	—	—
Tensile Str, 1000 Psi:					
Chill Cast:	—	10.5	10	—	6.8
Elong in 2 In., %:					
Chill Cast	—	4	5	—	8
Hardness, Bhn:					
Chill Cast	21	22	20	18	15
Fatigue Strength (End Limit) 1000 Psi:					
Chill Cast	—	4[1]	3.9[1]	—	—
Compressive Yield Str, 1000 Psi:					
Chill Cast 0.125% Set	3.8	3.6	3.4	3.4	3.0
Compressive Str, 1000 Psi:					
Chill Cast 25% Deformation	14.5	15.6	15.6	15.4	12.8
FABRICATING PROPERTIES					
Casting Temp F:					
Chill	655	640	645	630	630
CORROSION RESISTANCE	Resistant to corrosion by the usual lubricants.				
AVAILABLE FORMS	Small ingots and bars.				
USES	General purpose bearing alloy.	General purpose bearing alloy under moderate loads.	Light loads and moderate speeds. Mining machinery, transmission machinery, car journals.	Light loads and speeds. Blowers, pumps, electric motors, machine tools.	Suitable for light loads.

(Continued on page 147)

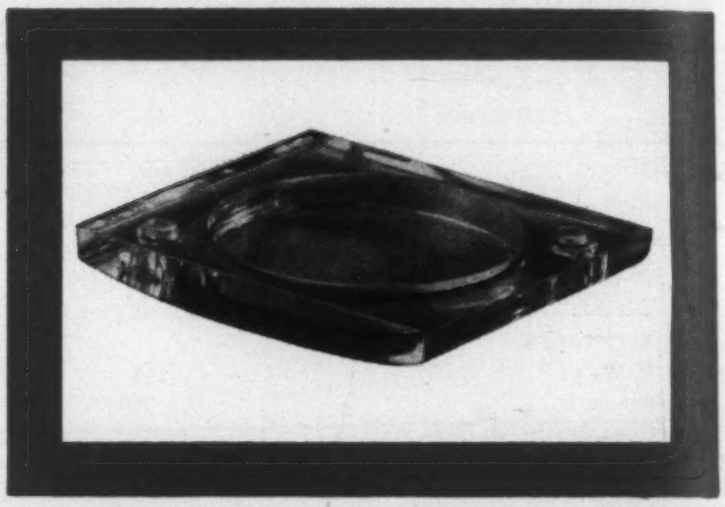


The Hannifin "Air Warden" filter-regulator-lubricator for air-driven equipment has bowls of tough, transparent BAKELITE C-11 plastic. One holds water with impurities collected from the air. The other, lubricating oil for atomizing into air stream. They withstand temperatures up to 125°F., air pressure of 150 psi. **Molded by E. Mills Corp., Chicago, Ill., for Hannifin Corp., Chicago, Ill.**

These sturdy, colorful dishes molded of BAKELITE C-11 plastics are light in weight, low in cost. They resist breakage, staining, attack by foods, soaps and detergents. **Made by Gits Molding Corporation, Chicago, Ill.**



Thermostat housings, injection-molded of BAKELITE C-11 plastic, have good detail, impact strength, smooth finish. Easily spray-coated with metallic paint. Easy moldability reduces production cost and mold maintenance. **Made by Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.**



This transparent protective cover used on levels made by the Empire Level Mfg. Co. is BAKELITE C-11 plastic. It provides a neat, attractive appearance, high mechanical strength, less chance of breakage if dropped. **Made by National Lock Co., Rockford, Ill., for Empire Level Mfg. Co., Milwaukee, Wis.**

C-11 plastics present
New fields for improved product design

BAKELITE C-11 acrylonitrile-styrene copolymers fill a void in the plastic material structure. They offer you a range of new properties, new uses, new service records not obtainable with other types of plastics.

BAKELITE C-11 materials resemble both acrylic and styrene plastics in some respects, yet have distinct advantages over both. Their chemical resistance is excellent. They withstand contact with soaps, detergents, oils, food chemicals, coffee, tea, citrus peels, and cosmetics. Tensile and flexural strengths are 45% higher than those of standard polystyrenes.

In addition to the applications illustrated, C-11 materials are employed for high-quality drafting instruments requiring dimensional stability. Other uses include containers and closures for the packaging of products made with essential oils mixed with non-volatile diluents.

Possessing good color, clarity, and lightness in weight, BAKELITE C-11 plastics present opportunities for many new applications in widely varied fields. For more information, write Dept. EP-17.

BAKELITE
TRADE-MARK
C-11 PLASTICS

TRADE B MARK

BAKELITE COMPANY
A Division of
Union Carbide and Carbon Corporation
30 East 42nd Street, New York 17, N.Y.
In Canada:
Bakelite Company (Canada) Ltd., Belleville, Ont.

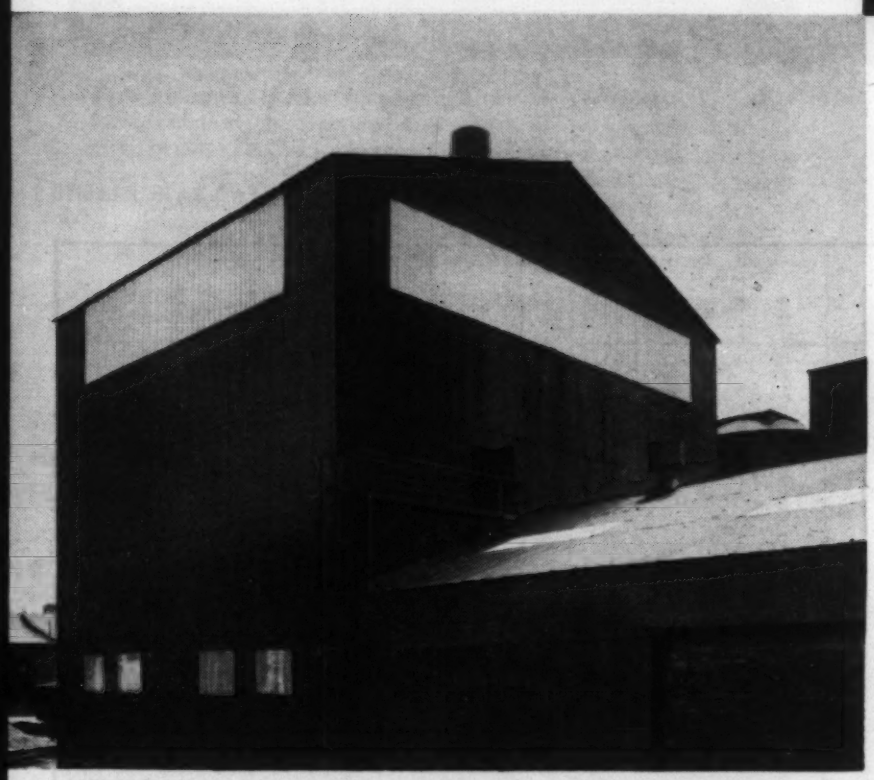
NUMBER 239 (continued) LEAD-BASE BABBITS

Type / ASTM Grade	12	15	16	19
COMPOSITION, %	Sn — Sb 10 Pb 90 Cu — As —	Sn 1 Sb 15 Pb Rem Cu 0.5 As 1.0	Sn 10 Sb 12.5 Pb Rem Cu 0.5 As —	Sn 5 Sb 9 Pb Rem Cu — As —
PHYSICAL PROPERTIES				
Density, Lb/Cu In.	0.384	0.362	0.355	0.378
Melting Range, F	498–473	538–479	495–471	495–462
Thermal Cond, Btu/Hr/Sq Ft/Ft/F, @ 212 F.	—	—	—	—
Coeff of Exp per F:				
68–212 F	14.6×10^{-6}	—	—	—
Spec Ht, Btu/Lb/F:	0.065	—	—	0.065
Elect Res, Microhm-Cm @ 68 F	25.6	—	—	28.7
MECHANICAL PROPERTIES				
Mod of Elast in Tension, Psi	—	4.2×10^6	—	4.2×10^6
Tensile Str, 1000 Psi:				
Chill Cast	—	10.4	—	10
Elong in 2 In., %:				
Chill Cast	—	2	—	5
Hardness, Bhn:				
Chill Cast	14	21	28	18
Fatigue Strength (End Limit) 1000 Psi:				
Chill Cast	—	4.3[1]	—	3.7[1]
Compressive Yield Str, 1000 Psi:				
Chill Cast 0.125% Set	2.8	—	—	—
Compressive Str, 1000 Psi:				
Chill Cast 25% Deformation	12.9	—	—	15.6
FABRICATING PROPERTIES				
Casting Temp F:				
Chill	625	660	620	620
CORROSION RESISTANCE	Resistant to corrosion by the usual lubricants.			
AVAILABLE FORMS	Small ingots and bars.			
USES	Suitable for light loads.	High loads and speeds. Diesel engines, automotive engines, steamships, various types of machines.	Moderate loads and speeds.	Light loads and speeds. Car journal bearings.

FOOTNOTES: *Light loads, under 1000 psi; moderate loads, 1000 to 2000 psi; heavy loads, over 3000 psi.*
Surface speeds, low to 10 ft per sec; moderate, to 20 ft per sec; high, above 30 ft per sec.
[1] *2×10^7 cycles.*

— for Quality with Economy . . .

EXTRUDED PLEXIGLAS

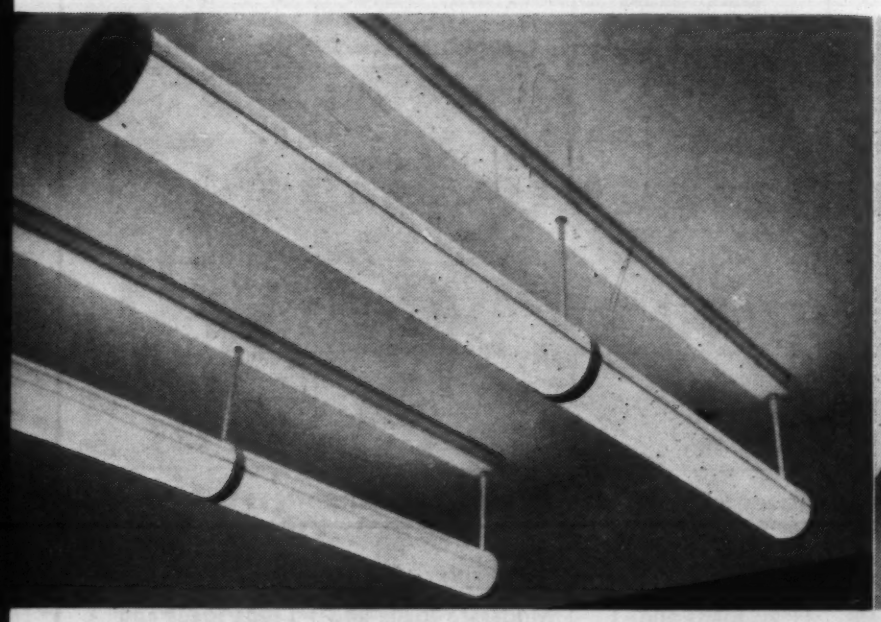


Industrial sidewall glazing, with extruded white translucent PLEXIGLAS, corrugated to match standard industrial siding.

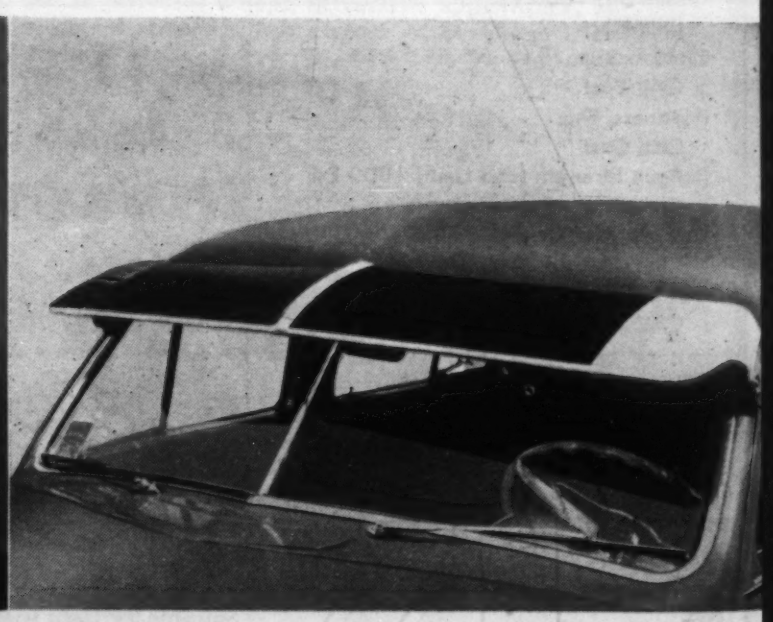
Continuous extrusion—using PLEXIGLAS extrusion-grade molding powder—can be a fast economical method of producing, at low cost, parts having uniform cross sections.

That's why designers are specifying extruded PLEXIGLAS for automobile sun visors, signs, lighting fixtures, counter dividers in retail stores, display fixtures . . . and for glazing prefabricated buildings and industrial structures where window breakage is a problem. These are only a few of the many existing and potential applications.

Extrusion Grade PLEXIGLAS molding powder does more than insure efficient production. Extruded sections have excellent gloss and clarity or color, and the resistance to heat, weather, and breakage for which PLEXIGLAS acrylic plastic is noted.



Totally enclosed lighting fixtures with extruded clear and white translucent PLEXIGLAS semicylinders.



Automobile sun visor with extruded green PLEXIGLAS sections, ribbed on upper surfaces.

(PLEXIGLAS *extrusions illustrated are produced by Sandee Manufacturing Company, Chicago, Illinois.*)

Send for NEW Booklet

Just published, this booklet shows the wide range of uses of PLEXIGLAS *molding and extrusion powders. Send today for your copy of* PLEXIGLAS *MOLDING POWDERS.*

PLEXIGLAS *is a trademark, Reg. U. S. Pat. Off. and in other principal countries of the Western Hemisphere.*

CHEMICALS FOR INDUSTRY

ROHM & HAAS COMPANY

WASHINGTON SQUARE, PHILADELPHIA 5, PA.

Representatives in principal foreign countries

New Materials and Equipment

New Portable Equipment Facilitates X-ray Inspection

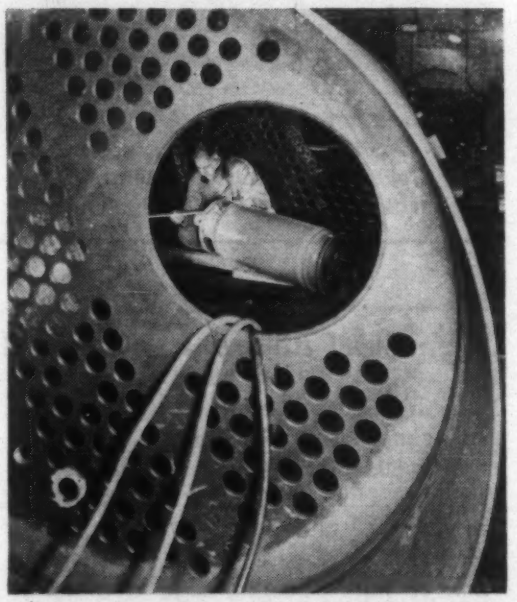
A new type of portable x-ray apparatus, recently announced by the X-Ray Dept. of *General Electric Co.*, 4855 Electric Ave., Milwaukee, is said to be capable of radiographing anything from light alloys to 3½ in. of steel.

Less than 15 in. in dia and 44 in. long, the unit is 56% smaller in size than the conventional 250,000-volt x-ray machine. The weight of the new unit is only one-eighth that of the conventional apparatus, being only 150, as compared to 1150 lb. It operates at from 75 to 250 kvp, and from 2 to 10 ma.

The new unit can be used in welding shops or foundries, or can be carried out on location for such projects as ship, dam and power plant-building, testing oil refinery cracking towers, laying pipeline, bridge construction, and any other construction work where the soundness of welded seams is vital to economical, trouble-free operation and safety.

According to the company, the unit can be adapted to inspecting products made of everything from magnesium to steel. Its use on light metals is possible, operating at lower voltages, because of the x-ray tube's beryllium window (x-ray exit port) which allows the soft or less penetrating rays to escape from the tube, instead of being absorbed as they are by other types of windows.

Secret of the unit's versatility is the multi-section x-ray tube that is grounded at the end. By thus providing protection from a 250,000-volt shock, this tube design makes possible letting the "snout" or x-ray source end of the tube protrude from the end of the tank. The snout can be inserted inside of pipes and castings to use the inside-out technique that greatly speeds the process of x-ray inspection and reduces problems of x-ray protection to the operators.



A new compact radiographic equipment, called Resotron 250, can operate in tight places.

High Temperature Metal-Sealing Thermosetting Plastic

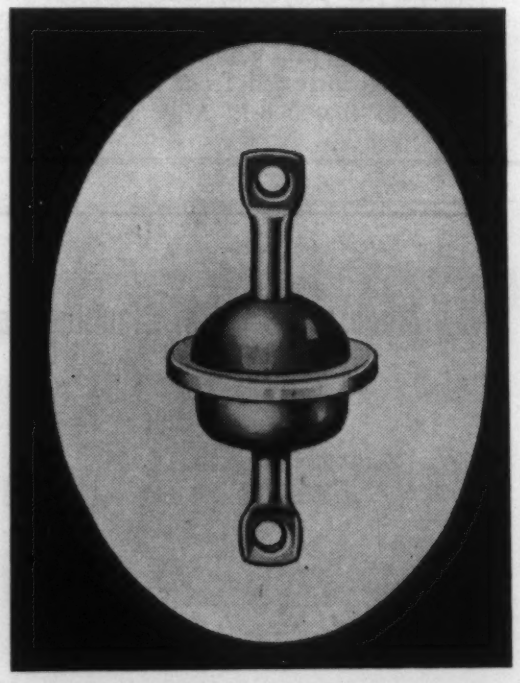
A new plastic material has been developed that is said to withstand continuous temperatures of 392 F and also to possess a high dielectric strength. Particularly advantageous where hermetic sealing and gas sealing under pressure are needed for perfect functioning of electrical components, the new material is already in production by *Melkor Research Laboratories, Inc.*, 11749 Detroit Ave., Cleveland 7.

Custom production will be available on all special types of applications for manufacturers of finished products requiring high temperature insulation combined with hermetic sealing. The terminal shown is being manufactured in three sizes—3/16-, 5/16- and ⅜-in. mounting holes.

Specifications

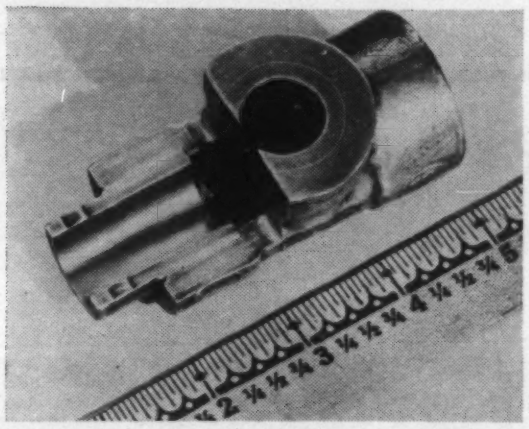
Dielectric Strength	8000 v - 60 cps
Corona Starting Voltage	2000 v - 60 cps
Air Pressure Test	30 lb
Terminal Pull	25 lb
Continuous Operating Temp	392 F
Short Period Temp 5 Min	500 F
Thermal Cycling 4 Cycles	—94 to 392 F
Thermal Cycling 4 when soldered ceases	85 F to 302 F

This terminal is fabricated from a high temperature metal-sealing thermosetting plastic.



New Materials and Equipment continued

Clad Brazing Alloys Permit Sound Blind Joints



This pipe fitting is one application of the new clad brazing alloys.

Silver brazing materials which are said to eliminate drawbacks of conventional silver brazing practices are currently being offered by *American Silver Co.*, 36-07 Prince St., Flushing, N. Y. Called Braze-Clad metals, the materials permit the achievement of flawless blind joints of long cross-section without reliance on the skill of the operator.

The metals are combinations of various base metals (ferrous and nonferrous) clad with a predetermined thickness of silver brazing alloy on one or both sides. The brazing alloy (available in a wide selection of melting points) is pre-diffused into the surface of the base metal by the application of heat and pressure. According to the company, the new materials eliminate voids and oxide islands, and produce joints that are effective over 100% of the bonding area, not just the usual 50 to 70%. They also cut fluxing and cleaning time, and simplify assembly set-ups by making conventional preplacements unnecessary.

This development is finding wide industrial applications—from aircraft bearing and electrical contacts to chemical equipment. Typical applications include: joints of large area, pressure-tight joints in high pressure pipe lines, and blind joints. They're also used for joining powder metal parts; for honeycomb structures; for joints of high strength.

High-Copper Alloy Has Improved Properties

A high-copper alloy containing nickel and phosphorus which makes it particularly well suited for the manufacture of springs, clips, high strength electrical conductors, bolts, nails, screws, cotter pins and many parts where the combination of high strength, high electrical or thermal conductivity, high resistance to fatigue and creep, and good workability are required, is being supplied by the *Chase Brass & Copper Co., Inc.*, Waterbury 20, Conn., a subsidiary of Kennecott Copper Corp.

In this "age hardening" alloy, called Phosnic Bronze, an aging treatment determines its properties and increases its tensile strength from about 38,000 to about 65,000 psi, while yield srength is said to be increased from approximately 10,000 to 40,000 psi. After age hardening, Phosnic Bronze, unlike some age hardening alloys in the heat treated condition, is suitable for severe cold working of any type. It is stated that aged Phosnic Bronze wire can be drawn to full spring temper.

The alloy is said to have greater creep strength than other alloys in comparable tempers, including cartridge brass, phosphor bronze or high-silicon bronze. This property makes it particularly well suited for bolt and structural material where high resistance to creep or flow under the influence of prolonged stress is most desirable.

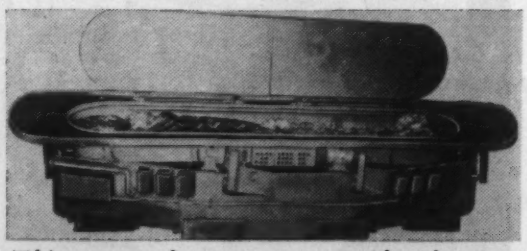
Depending on its physical condition, the alloy is suitable for varying degrees of cold work. In the full soft annealed state it is about as malleable and ductile as pure copper. After aging, it can still be cold worked extremely hard.

When furnished in spring temper, it can be tightly coiled and bent back on itself. It can be readily hot worked, but like other alloys, hot working removes the effect of previous cold working and age-hardening treatment.

The high strength of the alloy is due to the combined hardening effects of controlled age-hardening heat treatment and cold working by drawing or rolling. It is supplied as age-hardened only, or as age-hardened and cold worked in a range of tempers up to special spring temper.

Available round wire forms range in diameter from 0.016 to 0.650 in.; wire, rolled flat, 0.093 by 0.012 in. to 1.00 by 0.125 in.; round rod in diameters from 1/16 to 1¾ in.; and hexagonal rod from 1/16 to 1¼ in. across flats.

New Mechanical Metal Cleaning Equipment Offered



This general purpose metal cleaning unit combines many operations into one.

A complete new line of general purpose metal cleaning systems equipment has been designed by the *J. P. Manufacturing Co.*, 330 E. Front St., Youngstown 3, Ohio. Modern mechanical methods have been incorporated in these units to combine high-pressure immersion degreasing, washing, stripping and cleaning in one operation; derusting, descaling, pickling and corrosion removal; high-pressure rinsing and anti-rusting preparation; bonderizing, phosphatizing, rust proofing and paint bonding.

The units are said to mechanically drive off all grease, oil, sludge, gum, varnish, paint, carbon, chips preservatives, filings and dirt deposits; to remove all rust, scale, corrosion and like deposits without harmful effects to the basic metals.

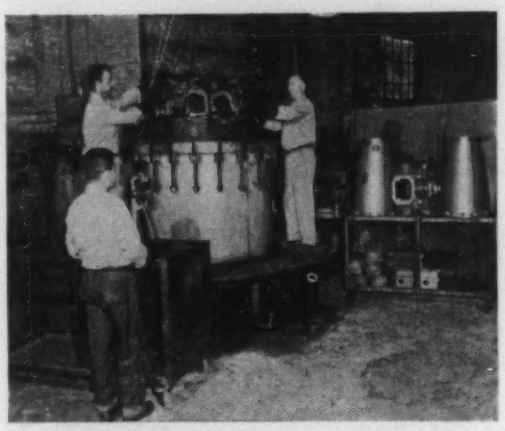
Impregnation Process Successfully Salvages Porous Castings

A new combination of sealing materials and impregnation methods now makes possible 100% filling of microporous voids in metallic castings, according to an announcement by *Polyplastex International, Inc.*, 441 Madison Ave., New York City. Thus, solution of an old foundry problem—salvage of casting rejected because of microporosity—can now be achieved on a regular production line basis.

The process utilizes a specially formulated thermosetting resin known as Polyplastex MC, plus a combination of vacuum and pressure. The resin is said to be 100% reactive—that is, all of the sealant converts into a solid of excellent physical and chemical properties. Therefore, when the liquid resin fills all of the pores, it occupies the same volume after it becomes solid. According to the company, the impregnating resin is resistant to a wide variety of solvents, water, salts, hydrocarbons and glycols, as well as acids and weak alkalis. The cured resin, they say, can withstand continuous exposure to temperatures up to 350 F. Although it is hard, the resin is resilient enough to allow for expansion and contraction of the metal due to variations in temperatures.

Both ferrous and nonferrous metals can be economically processed by the new method. Perhaps its greatest use is in aluminum and magnesium castings, since microporous flaws are particularly prevalent in low-density metals.

The new impregnation process has also been adapted to many armed services applications, such as a bronze flame-thrower part which is used with aromatic hydrocarbons under high pressure, magnesium castings for radio and electronic equipment, a small aluminum alloy casting in which carbon dioxide is compressed for an inflatable life jacket, a complex magnesium aircraft engine control casting, aluminum castings for radar devices and ordnance equipment, and magnesium units for fire control systems. The process is particularly recommended for pressure type castings, including such units as fuel pumps, valves, carburetors, radar and range finder parts, lubricating components, etc.



A new impregnation process utilizes a thermosetting resin combined with vacuum and pressure.

Copper-Clad Steel Plate Combines Many Properties

Commercial production of a new engineering material, copper clad steel plate, combining the special properties of copper and steel, has been announced by *Lukens Steel Co.*, Coatesville, Pa. These steels are expected to meet a long-felt want for many electrical, heat transfer and corrosion applications requiring copper's high conductivity and corrosion resistance combined with steel's low cost, strength and rigidity. Applications will include electrical apparatus evaporators, hot water heaters, heat exchangers, tube sheets, tanks and vessels.

Combining good chemical and physical properties with good fabrication characteristics, copper-clad steels are expected to simplify problems of equipment and fabrication in many types of applications. Fabrication time can be cut considerably, reducing production costs. For many types of equipment a smaller thickness of copper-clad steel can serve the same purpose as a thicker section of solid copper, reducing materials costs and saving space and weight.

Available in plate gages only, the steel consists of a layer of copper permanently and uniformly bonded to one side of a carbon steel backing plate. Cladding percentages of 10, 15 or 20% of total plate thickness will be regularly furnished in plate sizes up to 120 in. in width, 380 in. long and 3/16 to 1¼ in. thick. The new product is also available in either flanged only or flanged and dished heads.

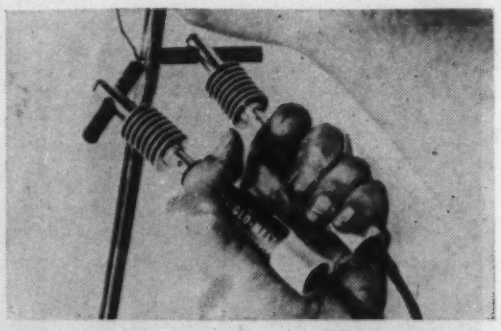
Homogeneous and dense in structure, the copper is unchanged in any way by being bonded to the steel. Characteristic special corrosion resistance and excellent electrical conductivity are said to be assured. Two types of cladding are regularly furnished: oxygen-free high conductivity copper for special electrical applications, and phosphorous deoxidized copper for improved weldability.

Mechanical properties are governed by the type of backing steel used. Backing steel can be any of the plain carbon or low alloy steels of flange or firebox quality conforming to ASTM or ASME specifications. The clad-steels can be formed, sheared or rolled according to the standard procedures. Uniformity of cladding thickness facilitates fit-up and aids welding.

Helpful Accessory for Resistance Soldering Unit

The Pliers Handpiece, a brand new accessory for the Glo-Melt resistance soldering unit, has been announced by the *Wasserlein Manufacturing Co.*, 126 W. Cass St., Joliet, Ill. By eliminating the need for a separate ground connection to the article to be soldered, this device is said to provide greater convenience in soft soldering through the resistance principle.

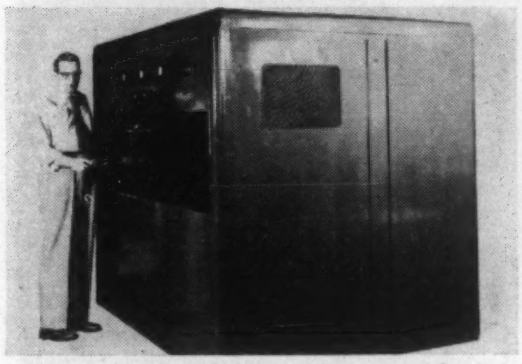
It is particularly suited for soldering connection on copper tubing and similar materials. The handpiece holds two carbon tips which are ground flat at a slight angle to make good connection to both sides of any tubular joint. It will function effectively on tubing up to ⅝-in. o. d. and on heavy terminals up to #000 AWG. It will also prove an efficient and practical tool for plumbers, etc.



Accessory for resistance soldering units eliminates need for ground connection.

New Materials and Equipment continued

High Frequency Induction Heating Unit



This induction heating unit provides 50 kw at 400,000 cycles per sec.

Lindberg Engineering Co., 2450 W. Hubbard St., Chicago 12, has added a new 50-kw high frequency unit to its line of high frequency induction units. Model LI-50A-1 is being built to provide more than 50 kw at 400,000 cycles per sec on a 100% duty cycle.

The units are recommended for heating and fabricating operations which call for production brazing, soldering, hardening, forging or shrink fitting at reduced cost and floor space.

Specifications:

Output—5 kw—2840 Btu per min, 400,000 cycles per sec. (approx.)

Input—230, 460, 550 v, 3 phase, 60 cycles. 100 Kva max. 90% power factor, 3 Kva (idling)

Water—Consumption determined by use. Average at full load 22.5 G.P.M. Pressure 20 to 80 lb.

Dimensions—96 in. wide, 68 in. deep, 80 in. high.

Weight—5400 lb without accessories.

The unit features a built-in closed water system that circulates temperature controlled water to the oscillator tube and tank coils.

Resin-Base Single-Coat Finish Resists Corrosion

A new, resin-base, single-coat finish, applied with spray guns, has been announced by *The Glidden Co.*, Cleveland. Called Nu-Pon A, the new finish is said to resist successfully the attacks of chemicals, corrosion and moisture.

Ideal for marine or farm use, where a strong, durable, resistant metal finish is needed, one finish coat of Nu-Pon A is said to do the work of four or five coats of paint previously used for most exterior metal finishes required to withstand extremely adverse conditions.

Only a few of the number of uses for Nu-Pon A have been determined, but initial use of the new finish was in the chemical industry to protect huge metal tanks from the ravages of the contents, weathering, and air-borne chemicals.

The resin base for the new finish was first discovered from petroleum products. Company researchers recognized possibilities of the new material, and from it formulated the Nu-Pon line. They have found extensive use for it in baking base coats or primers used in the appliance industry.

Later, a catalyst was discovered which, when used with a modified Nu-Pon finish, permitted polymerization to take place at normal air-drying temperatures, thereby making the finish adaptable to field maintenance.

A new kind of spray gun was developed for its application. The new gun employs the use of two fluid feeds—one for Nu-Pon A, the other for the catalyst. The two materials are mixed in the air and the resultant paint begins to cure as it strikes the surface being finished.

According to the company, the quick-setting feature allows the building up of a single coat of the finish to a thickness of more than 10 mils without running or sagging, whereas ordinary finishes are applied to a thickness of approximately one to two mils.

Buttwelding Machines Provide Precise and Uniform Welds

Primary application of this buttwelder is the production of cylindrical forms.

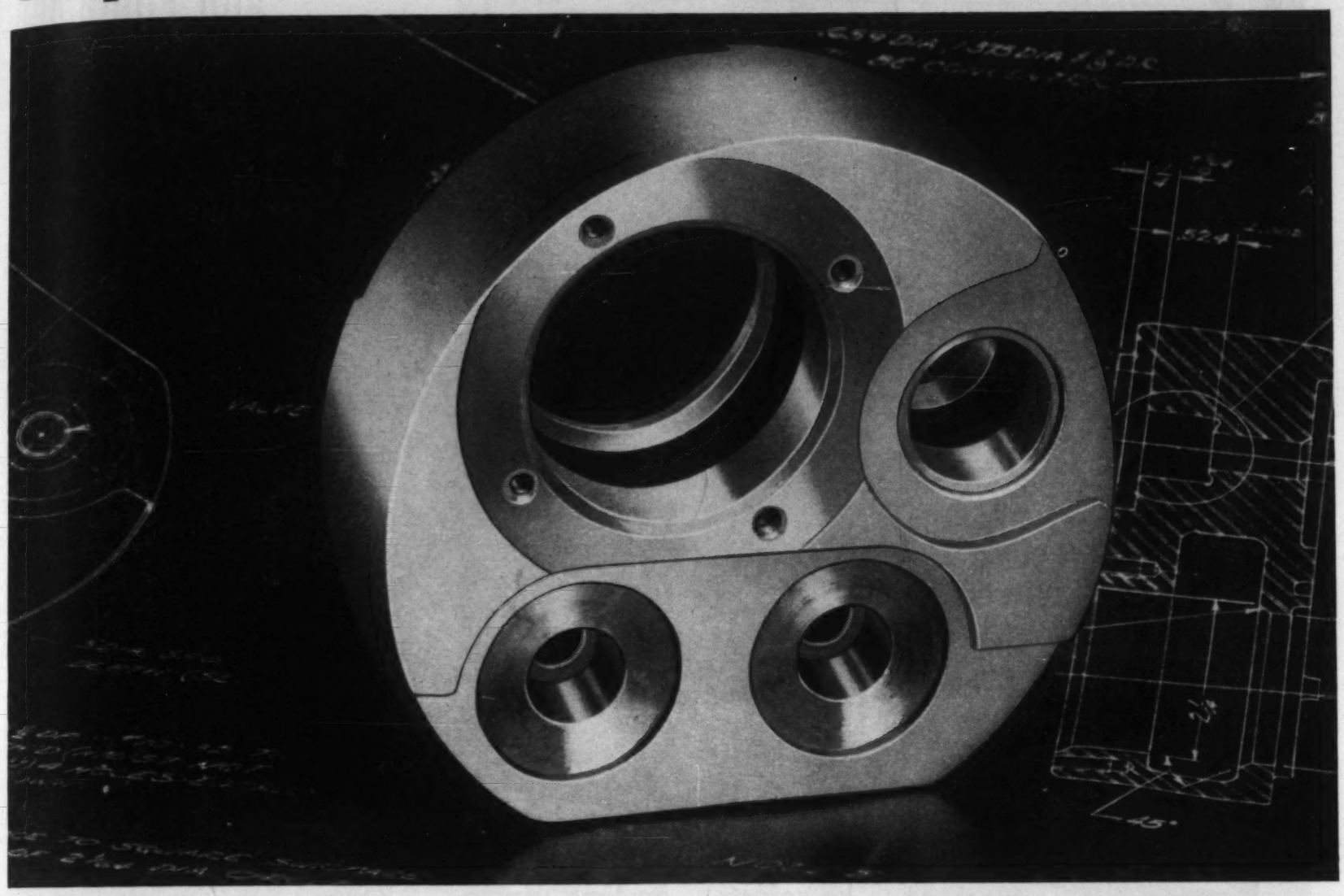
Originally designed for company use, two models of buttwelding machines are currently being offered to industry by *Solar Aircraft Co.*, 2200 Pacific Highway, San Diego 12. Primary application of the machine is the production of cylindrical forms from flat sheets or strips. Similarly, many open-end cones, ovals and square forms are welded in a wide range of diameters, lengths and gages. Sheets of non-standard size can be produced easily by joining flat sections.

The units are available in two standard sizes; one which welds seams up to 30 in. long, and a larger model which welds seams up to 66 in. in length. Several intermediate sizes can be obtained through relatively simple modifications of the standard design.

Solar buttwelders are said to provide highly precise and uniform welds of the inert arc type and to be easily operated by semi-skilled workers. The specially-designed work holding clamps result in strong, ductile weldments, generally without the use of filler wire. The units easily handle the usual variety of materials and thicknesses found in aircraft and industrial sheet metal shops.

(More News on page 154)

Only *MERCASTING** can make this as a unit!



*FROZEN MERCURY INVESTMENT CASTING

PROBLEM:

Three expensive machined parts were formerly required to get the necessary internal cavities for this valve body. Use on an electronic tube evacuator made special tolerances necessary. After assembly by welding, re-machining, and testing, a large part of the total production was rejected for failure to meet the rigid specifications of the manufacturer—Distillation Products Industries, Division of Eastman Kodak Company, well-known producer of high-vacuum equipment.

SOLUTION:

DPI brought the problem to Alloy Precision Castings Company. Cooperating Alloy foundry engineers and metallurgists developed the pictured one-piece, 5½-lb. mercasting of 303 stainless. The "as-cast" piece can be held to an average plus or minus .003 inch per inch on certain critical dimensions. A comparatively small amount of finish machining is needed on valve seats and tapped holes.

A-6295

SUMMARY:

The illustrated mercasting is a better valve body easily produced in a more desirable material. Tremendous savings are effected through elimination or drastic reduction of special tooling, machining, waste material, and scrapped production.

Send prints of your problem parts today. Learn how Alloy Precision can save you time and money.

ALLOY PRECISION CASTINGS COMPANY, DEPT. B-2
45th and Hamilton, Cleveland 14, Ohio

Please RUSH Bulletin 706 describing the Mercasting Process.

NAME _____

TITLE _____

COMPANY _____

ADDRESS _____

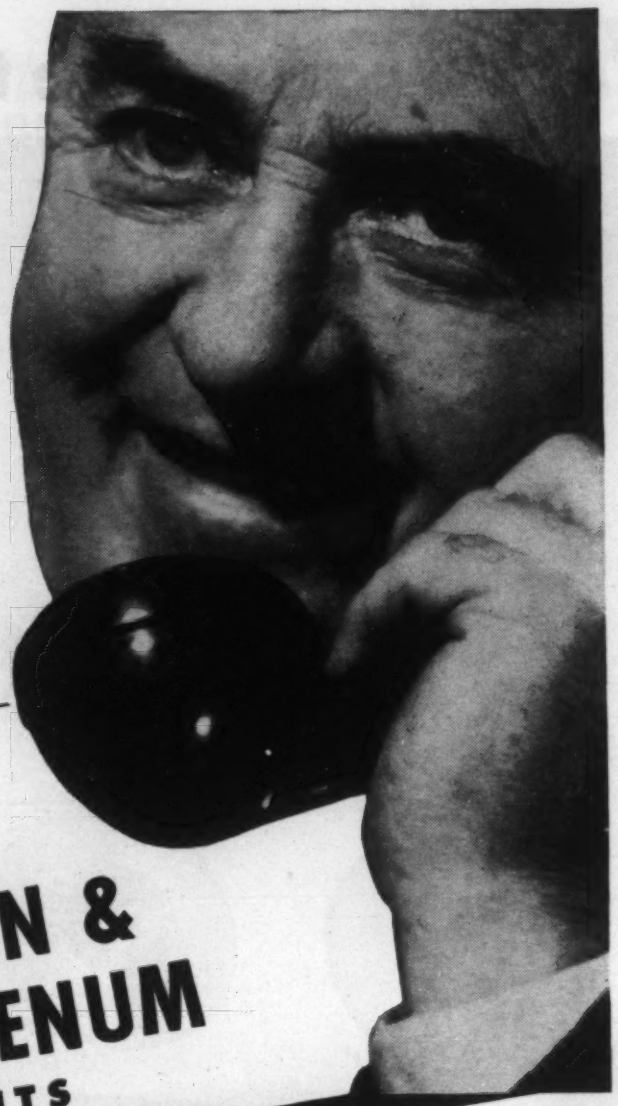
CITY _____

ZONE _____ STATE _____

ALLOY PRECISION *Castings Company*

EAST 45th ST AND HAMILTON AVE. • CLEVELAND 14, OHIO

"PARTS not pounds!"



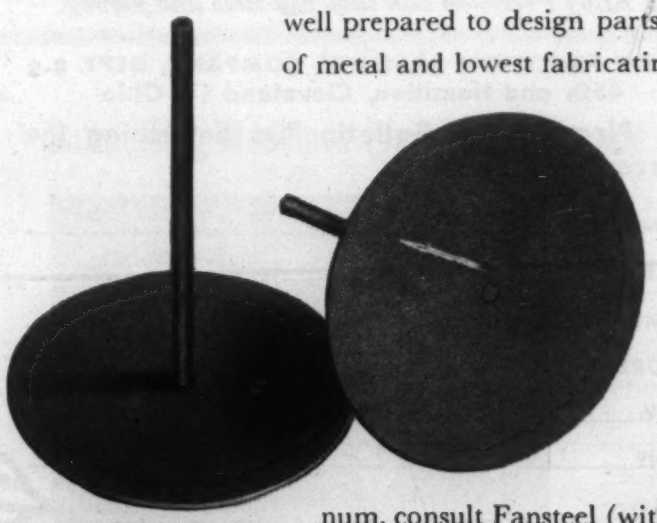
...we let

Fansteel FABRICATE OUR TUNGSTEN & MOLYBDENUM COMPONENTS

EWING GALLOWAY

no scrap... no rejects... no time waste

Whether you want semi-fabricated blanks or completely finished parts, you will save by letting Fansteel fabricate your tungsten and molybdenum components for you. Fansteel maintains complete facilities for fabricating, including forming, stamping, bending, deep drawing, forging, machining, brazing, welding, assembly and finishing. You'll find Fansteel engineering assistance valuable, too. Fansteel engineers are long experienced in the fabricating techniques peculiar to tungsten and molybdenum, and are well prepared to design parts with the minimum amount of metal and lowest fabricating costs.



Anodes for hydrogen thyratron electronic tubes. The disks are heavy molybdenum sheet. The shafts are made of tungsten rod.

If you are a user of tungsten and molybdenum, consult Fansteel (without obligation) for assistance in design and most economical fabrication.

FANSTEEL WORLD'S LARGEST PRODUCER OF REFRACTORY METALS

Write for the informative booklet: "FANSTEEL TUNGSTEN AND MOLYBDENUM"

TUNGSTEN & MOLYBDENUM

22501C

Fansteel Metallurgical Corporation NORTH CHICAGO, ILLINOIS, U.S.A.

New Materials and Equipment

Welded Aluminum Heat Exchanger Tubes

Low cost, plus double-barreled protection against corrosion, are advantages claimed for the welded aluminum heat exchanger tubes currently being produced by *Aluminum Co. of America,* 801 Gulf Bldg., Pittsburgh 19. The new tubes are made by longitudinally butt welding Alclad 3S-H12 aluminum alloy sheet, rather than drawing seamless aluminum tubes. This same process can be used in making tubes for applications other than heat exchangers.

In the two standard sizes now available, 1-in. outside dia with 0.049-in. and 0.065-in. wall thicknesses, welded aluminum heat exchanger tubes are said to cost 20% less than seamless aluminum tubes and substantially less per foot than tubes of other commonly used metals.

In addition to being lower in cost than tubes made from other metals, the welded tubes have the protective Alclad coating on both the inside and outside surfaces, rather than on the inside only as in seamless aluminum tubes.

Weight tolerances, tube expansion, hydrostatic pressure tests and dimension tolerances, except for slight deviations in the weld area, are the same for 3S-H12 welded tubes as for seamless 3S-H14 tubes.

Typical tensile strength for Alclad 3S-H12 tubes is 17,000 psi and yield strength, 14,000 psi. In trial installations, though allowable internal working pressures generally average 2/3 those of seamless tubes, the welded tubes have performed satisfactorily.

Corrosion tests made by the company's research laboratories on the new tubes have shown that Alclad coating gives protection to the weld area. During manufacture of the tubes, the outside weld bead is removed and the small inside weld bead is flattened.

Standard lengths of the 1-in. outside dia welded tubes are 12, 14, 16 and 20 ft, but other lengths between 10 and 24 ft can be ordered.

In a few months Alcoa expects to be producing ¾-in. welded tubes.

Low-Cost Coating Resin Is Durable

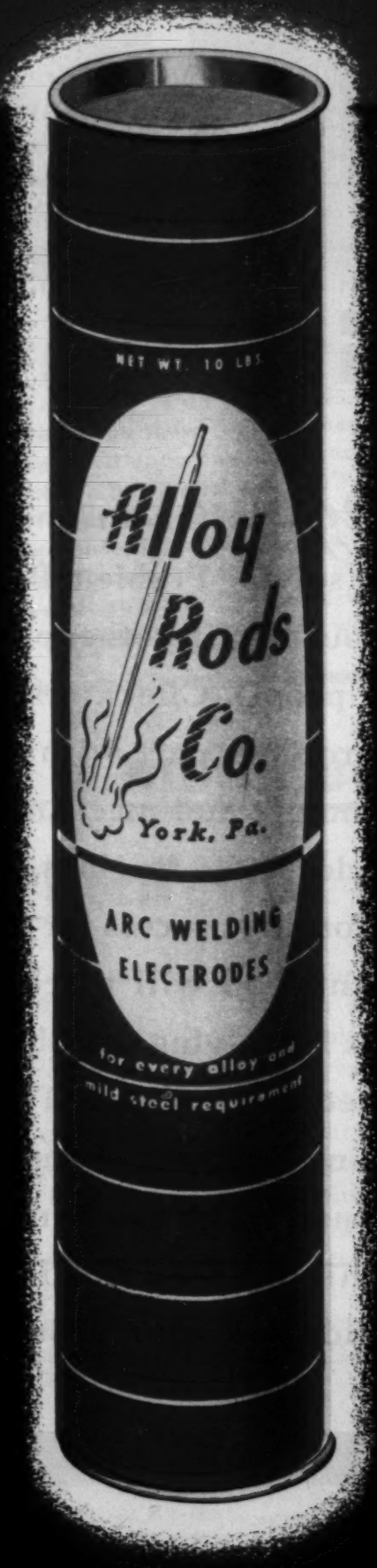
Rohm & Haas Co., 235 S. 8th St., Philadelphia, has announced the development of Acryloid B-82, 100% solids. This resin is a water-white solid polymer of an acrylic type ester. It is said to possess excellent clarity and resistance to chemicals, to be durable and to have low pigment reactivity.

Welders everywhere will tell you there are NO FINER ELECTRODES MADE... ANYWHERE!

ARCALOY stainless steel electrodes for every stainless steel welding requirement. Lime coating for all-position welding, reverse polarity. AC-DC coating for chrome-nickel steels with all types of AC or DC welding equipment. Twenty-three regular analyses, plus several special analyses. *Write for Bulletin 5751.*

BRONZE-ARC phosphor bronze electrodes for all-position welding with reverse polarity on DC. Smooth, easy-flowing arc eliminates any erratic arc action. Makes superior low-spatter, dense, porosity-free, high-strength welds on bronze, brass, copper . . . excellent to join dissimilar metals. *Write for Bulletin AR53-1.*

NICKEL-ARC, NICKEL-ARC 60 electrodes for cast iron. Nickel-Arc 60 is the finest electrode available today for cast iron welding. Like the well-known Nickel-Arc, it has a smooth arc and spatter-free action with AC or DC. Soft machinable deposit is ideal for repairing broken or worn castings. *Write for Bulletin 2218.*



TOOL-ARC electrodes for tools and dies weld each of the five basic types of tool and die steels including: oil hardening, hot work, water hardening, high speed, and air hardening . . . also for work hardening applications. Conserves material, saves man hours, and minimizes production delays. *Write for Bulletin AR52-1.*

WEAR-ARC hard-facing electrodes for fast, economical, efficient rebuilding and hard-facing to resist abrasion, impact, compression, corrosion, and heat. Nine basic types for correcting specific wear patterns, reclaiming worn equipment and parts, guarding against future wear. *Write for Bulletin 5651.*

WELD-ARC low hydrogen electrodes for welding high carbon, high sulphur, free machining, and other difficult-to-weld steels, with AC or DC. Low spatter loss, high deposition efficiency, very quiet arc action, free from tendency to undercut, welds free from under-bead cracking. *Write for Bulletin AR51-1.*

Alloy Rods Co.

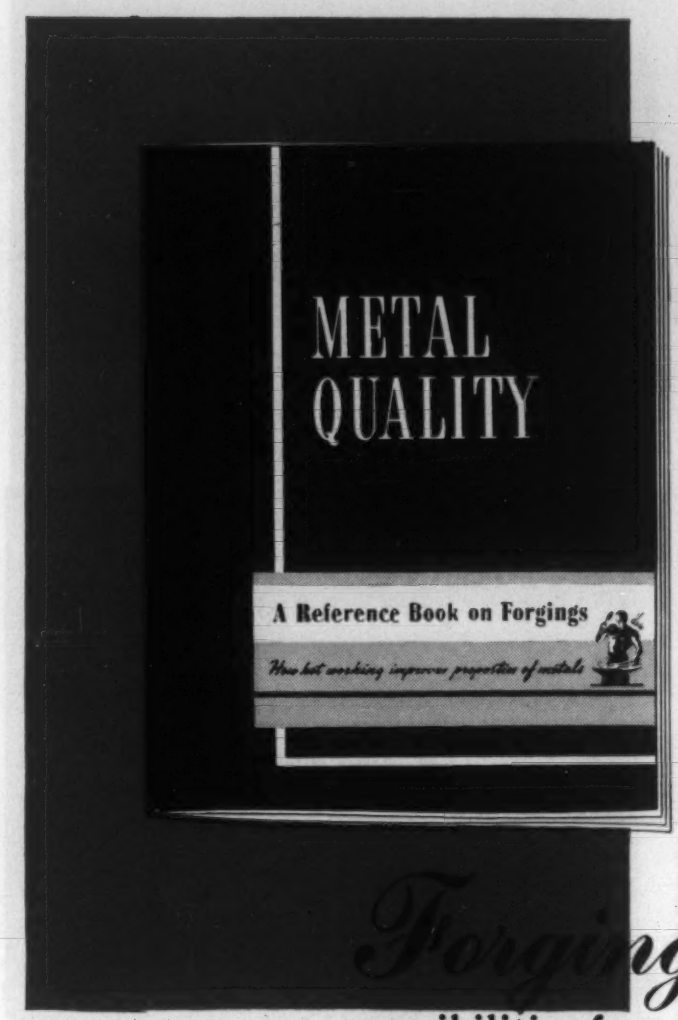
LOOK FOR THE FLAMING ARC TRADEMARK

AR-11

Packaged in the familiar Alloy Rods red and yellow all-metal moisture-proof containers, every rod reaches you in "oven fresh" condition.

ALLOY RODS COMPANY
YORK, PENNSYLVANIA

NO FINER ELECTRODES MADE... ANYWHERE



Engineering, production and economic advantages obtainable with forgings are presented in this Reference Book on Forgings. Write for a copy.

Forgings **offer unlimited possibilities for solving Problem Parts Problems without creating other problems for other people. Check all the aspects of a problem part with the unrivaled economic and mechanical advantages of closed die forgings, and the closed die forging process for producing parts, and you will discover the possibilities for solving a problem part with closed die forgings. Then, consult a Forging Engineer about the correct combination of mechanical properties which closed die forgings can provide for your product.**

DROP FORGING ASSOCIATION
605 HANNA BLDG. • CLEVELAND 15, OHIO

Please send 60-page booklet entitled "Metal Quality—How Hot Working Improves Properties of Metal", 1949 Edition.

Name _____

Position _____

Company _____

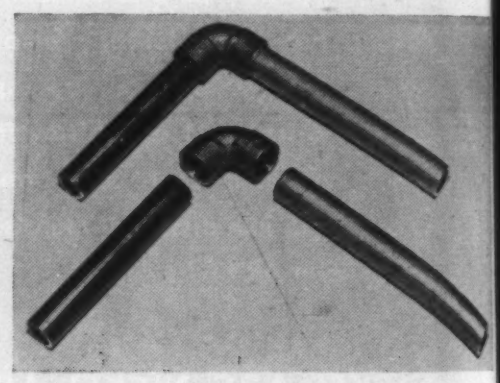
Address _____

New Materials and Equipment

The resin does not have a sharp melting point, but softens instead in the range of 70 to 80 C and flows at 140 to 155 C. It is available as a 40% solution in toluol, in which form it has a viscosity of 400 to 700 Centipoises.

Soluble in toluol, xylol and other aromatics, Acryloid B-82 can be put into solution using conventional tumbling barrels, pebble mills, or shellac cutting equipment. For laboratory work, the resin can be dissolved conveniently in jar mills or in cans or bottles placed on rotating rolls.

The new resin can be used for the production of many specialty coatings for wood, metal, plastic materials and fabrics. Its crystal clarity makes it particularly attractive for novelty and decorative coatings on silverware, brass lamps and hardware. It is a good vehicle for fluorescent and phosphorescent pigments because of its low reactivity with these sensitive materials.

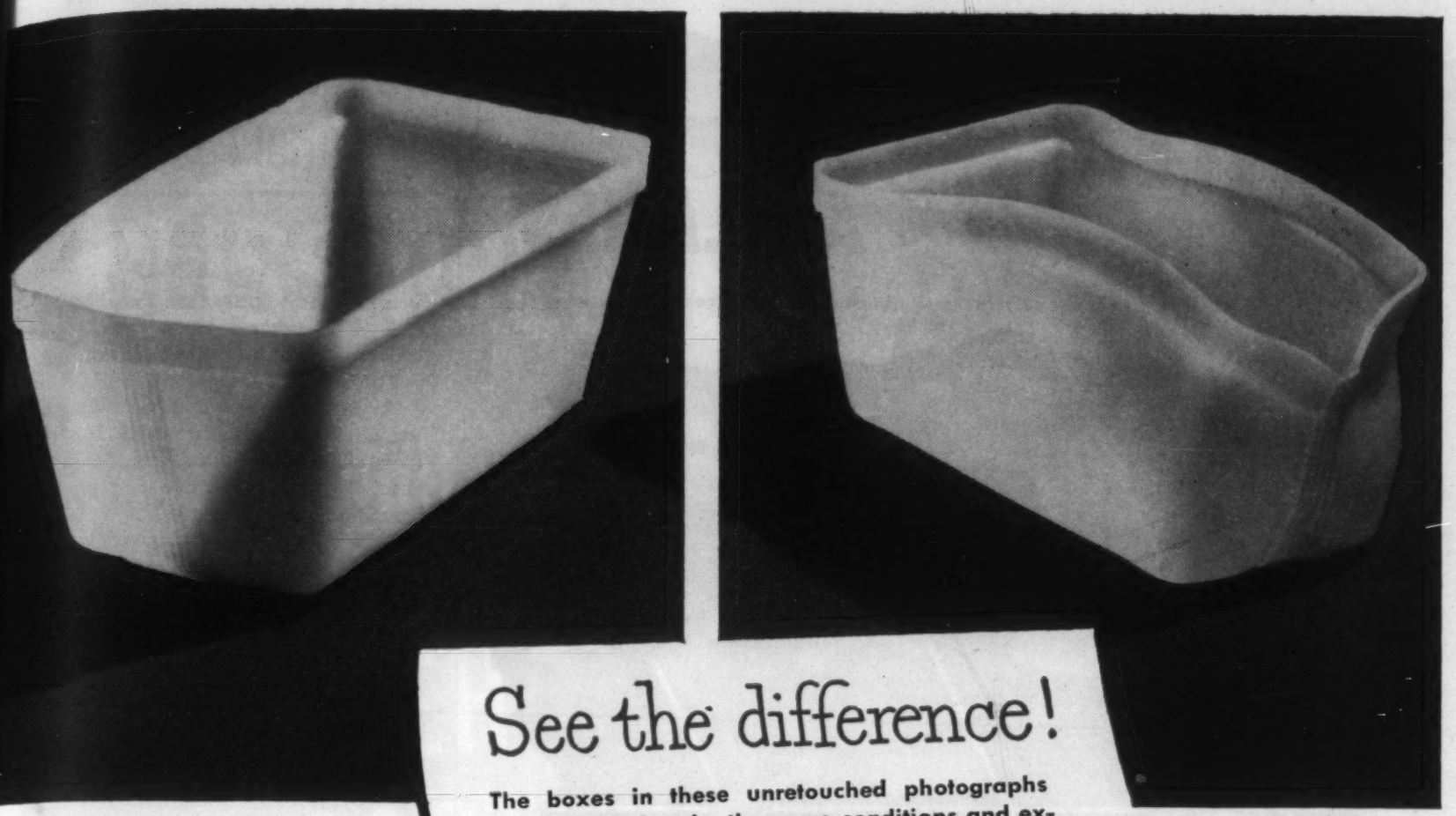


Bonding Agent Joins Dissimilar Metals

A bonding agent, ChemoTec, especially formulated for joining metals to each other, to similar or dissimilar metals, or to nonmetallic materials such as ceramic, glass or wood, has been made available by the *ChemoTec Div., Eutectic Welding Alloys Corp.*, 172nd St. and Northern Blvd., Flushing, N. Y. Available in rod, powder, paste or liquid forms, the adhesive is suitable for production joining of titanium, magnesium, aluminum, and similar difficult-to-bond metals.

In rod form it is applied with a welding-rod technique, but at a much lower heat, and tensile strengths in excess of 5,000 psi have been obtained. It bonds by capillary and chemical action, has high fluidity, and extraordinary wetting characteristics enable the thin flowing material to penetrate all but sealed joints.

The application of heat sets up a chemical reaction which changes the molecular



See the difference!

The boxes in these unretouched photographs were molded under the same conditions and exposed to a temperature of 212°F. The box on the left, made from Koppers MC 409, showed little or no distortion after 30 minutes at this temperature. The box on the right, made from a widely used commercial modified polystyrene, showed major distortion within 10 minutes.

high heat resistance in a modified polystyrene . . .

KOPPERS MC 409

• Here's the high-heat modified polystyrene that the industry has long wanted . . . Koppers MC 409.

This new material combines three important advantages . . . higher heat resistance *(up to 198°F.*)* . . . the toughness and shock resistance of modified polystyrene . . . and the desirable finish and molding characteristics of regular polystyrene. MC 409's excellent heat resistance is comparable to that of Koppers well known Polystyrene 8.

These qualities make MC 409 an ideal material for radio cabinets, battery cases, washing machine and refrigerator parts, toys, housewares, brush handles and, in fact, any molded or extruded polystyrene product subjected to heat.

Koppers MC 409 makes possible sturdy, shock resistant, plastic products that withstand the high temperatures found in show windows, dishwashers and automobiles, where other modified polystyrenes sag and shrink. Tests prove that on exposure to boiling water MC 409 will show low deformation with a minimum of shrinkage.

FOR FREE SAMPLES for testing in your laboratory and for Technical Bulletin C-2-161-TR describing the properties and characteristics of MC 409, write, wire or phone Koppers Company, Inc., Chemical Division, Dept. MM-112, Pittsburgh 19, Pa.

**A.S.T.M. D-648-45T.*

Koppers Plastics Make Many Products Better and Many Better Products Possible

KOPPERS®

Koppers Plastics

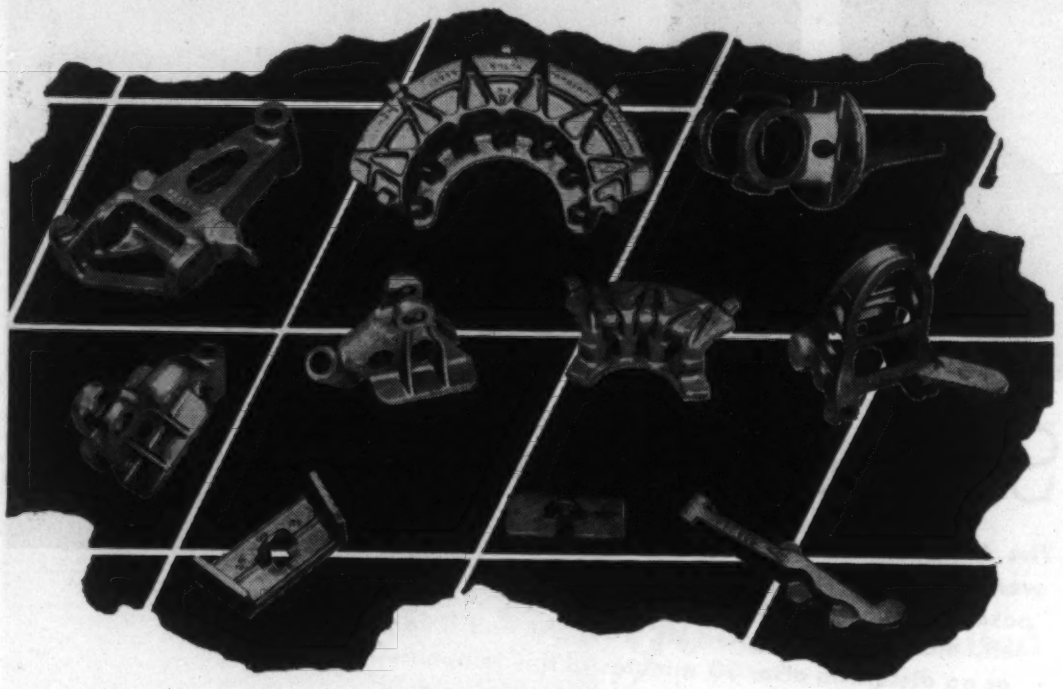
KOPPERS COMPANY, INC., Chemical Division, Dept. MM-112, PITTSBURGH 19, PA.

SALES OFFICES: NEW YORK · BOSTON · PHILADELPHIA · CHICAGO · DETROIT · LOS ANGELES

UNITCAST

Daily rides the **AIRLANES**

(Aircraft castings used directly or as an accessory attachment)



UNITCASTINGS

..ENGINEERED TO "TAKE IT"

Each of the above castings is the result of cooperative designs embodying the best-known foundry techniques available to assure the production of HIGH STRENGTH, MINIMUM WEIGHT, DEFECT-FREE castings. Each part is either percentage checked or 100% checked by radiographic and magnetic particle inspection.

Unitcast HAS met and WILL continue to meet the demands of industry, producing pre-determined TOP QUALITY castings, as shipped, and with personal follow-up to check machinability, fixture fit, assembly fit, etc., in YOUR PLANT.

Your successes reflect on our books. May we offer our services to challenge any knotty problem your product may present to the castings industry.

UNITCAST
Corporation
QUALITY STEEL CASTINGS

Give us a chance to offer a "cast steel" answer for your parts problem. Our suggestions while your product is in the design stage will pay continuous dividends.
Write or call today. Unitcast Corporation, Steel Casting Division, Toledo 9, Ohio. In Canada: Canadian - Unitcast Steel, Ltd., Sherbrooke, Quebec.

UNITCASTINGS ARE FOUNDRY ENGINEERED

New Materials and Equipment

structure and fuses the bonding material. The process gives a bond at the interface equal to the tensile strength of the bonding material itself.

As in the case with thin flowing brazing alloys, maximum strength is obtained from close fitting joints, and a joint clearance of from 0.004 to 0.008 in. should be maintained. The part to be joined is broadly heated to approximately 250 to 300 F. The rod acts as a temperature indicator, and sufficient material is applied to effect the joint. High wettability and thin flowing characteristics are said to enable a high strength bond to be made, regardless of the metallurgical structure of the materials bonded.

Thermo-Chemical Process Protects Metals from Corrosion

Stanwood Oil Corp., 72 Wall St., New York City, is now marketing a new process for the corrosion treatment of metals, known as the Permyron process. It consists of thermochemical treatment of metals which gives high resistance to mild steel and other ferrous metals.

Application requires a chemically clean surface that is treated hot under controlled conditions. The heat employed is not enough to temper and soften cold-rolled or other work-hardened steel. Since the material is absorbed into the pores of the metal in the process, coating does not change the dimensions to an exent which can be measured by a micrometer.

The process has been subjected to tests by various companies and independent laboratories, and all have reported favorable results. In commenting upon cost, company officials point out that the process is produced on specially controlled but standard coating and heat treating equipment and the cost per square foot or per piece is substantially the same as that of present methods or even baking-enamel finishes, except that Permyron has a low material cost factor. Metal subjected to the treatment forms an excellent dense undercoating or primer for paint or other decorative finishes either baked or air dry, forming an ideal inert, flexible base which is said to be highly resistant to attack by ordinary weathering or acid conditions.

The automotive industry is expected to be a prime field for the process as it contains many desirable features long sought by automotive engineers. It is an

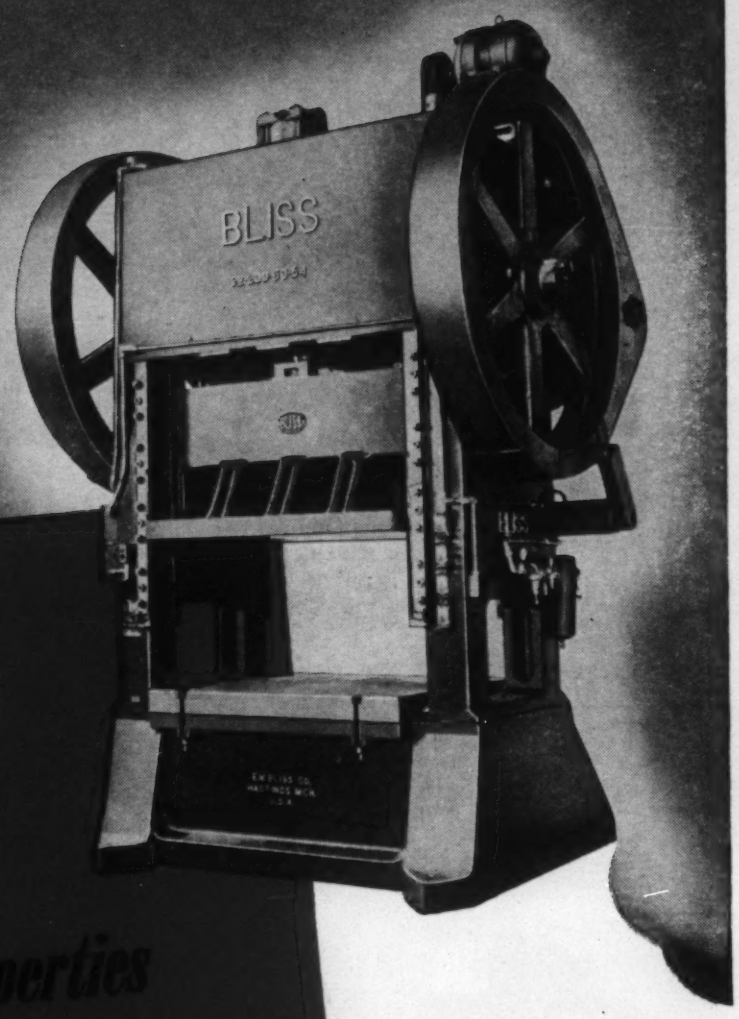
BLISS PRESSES

Famous for Sturdy Productivity

are built with

MEEHANITE® CASTINGS

Famous for Top Quality Properties



BECAUSE the production and management team of the E. W. Bliss Company, Canton, Ohio learned from experience that Meehanite castings could regularly provide the reliable range of top quality properties demanded by their specifications, they operate two foundries which produce these castings for all major component parts.

The Bliss S-2 Heavy Duty Press shown is built with the following 10 major castings:

1. *Press Bed*
2. *Crown*
3. *Connections*
4. *Uprights*
5. *Slide*
6. *Bolster Plate*
7. *Bearing Caps*
8. *Flywheel*
9. *Gibs*
10. *Gears*

As can be seen from this list, the Bliss line, noted for its rugged dependability, precision manufacture, and trouble-free service makes maximum use of the uniform dependability of Meehanite castings—castings processed to provide the right combination of properties for the job.

Today as in the past, in modern designs the "TREND IS TOWARD MEEHANITE CASTINGS." Investigate the many ways they can improve your product—production—quality.

Write for our new sound slide film "Meehanite Castings Serve All Industry."

Take *YOUR* Casting Problem To A MEEHANITE FOUNDRY

American Brake Shoe Co.	Mahwah, New Jersey
The American Laundry Machinery Co.	Rochester, New York
Atlas Foundry Co.	Detroit, Michigan
Banner Iron Works	St. Louis, Missouri
Barnett Foundry & Machine Co.	Irvington, New Jersey
E. W. Bliss Co.	Hastings, Mich. and Canton, O.
Builders Iron Foundry	Providence, Rhode Island
Compton Foundry	Compton, Calif.
Continental Gin Co.	Birmingham, Alabama
Crawford & Doherty Foundry Co.	Portland, Oregon
The Cooper-Bessemer Corp.	Mt. Vernon, Ohio and Grove City, Pa.
Empire Pattern & Foundry Co.	Tulsa, Oklahoma
Farrel-Birmingham Co., Inc.	Ansonia, Connecticut
Florence Pipe Foundry & Machine Co.	Florence, New Jersey
Fulton Foundry & Machine Co., Inc.	Cleveland, Ohio
General Foundry & Manufacturing Co.	Flint, Michigan
Greenlee Foundry Co.	Chicago, Illinois
The Hamilton Foundry & Machine Co.	Hamilton, Ohio
Hardinge Company, Inc.	New York, New York
Hardinge Manufacturing Co.	York, Pennsylvania
Johnstone Foundries, Inc.	Grove City, Pennsylvania
Kanawha Manufacturing Co.	Charleston, West Virginia
Lincoln Foundry Corp.	Los Angeles, California
E. Long Ltd.	Orillia, Ontario
Otis Elevator Co., Ltd.	Hamilton, Ontario
The Henry Perkins Co.	Bridgewater, Massachusetts
Pohlman Foundry Co., Inc.	Buffalo, New York
Rosedale Foundry & Machine Co.	Pittsburgh, Pennsylvania
Ross-Meehan Foundries	Chattanooga, Tennessee
Shenango-Penn Mold Co.	Dover, Ohio
Sonith Industries, Inc.	Indianapolis, Ind.
Standard Foundry Co.	Worcester, Massachusetts
The Stearns-Roger Manufacturing Co.	Denver, Colorado
Traylor Engineering & Mfg. Co.	Allentown, Pennsylvania
Valley Iron Works, Inc.	St. Paul, Minnesota
Warren Foundry & Pipe Corporation	Phillipsburg, New Jersey

"This advertisement sponsored by foundries listed above."

MEEHANITE®

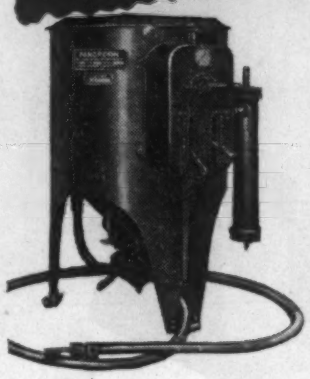
NEW ROCHELLE, NEW YORK

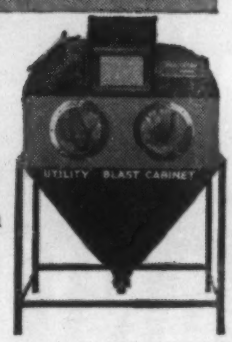
Here's how Pangborn

Solves these Problems

with this modern equipment

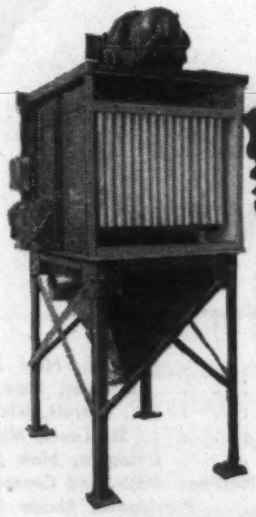
BLAST CLEANING!





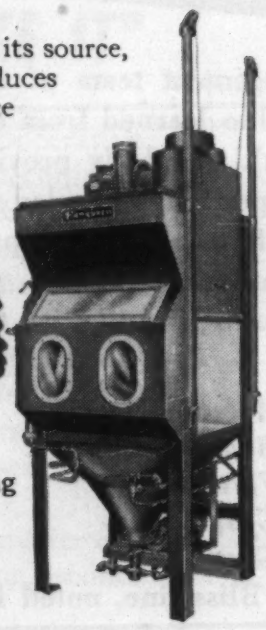
Blast Cleaning Cabinet quickly and easily cleans rust, grime, dirt, paint, etc., from metal parts. Produces a clean, smooth surface on pieces up to 60″ x 36″. Models available from $319.00 and up.

Blast Cleaning Machine not only removes rust, dirt, scale, etc., but is ideal for maintenance and many other uses. Cleans large objects such as bridges, structural work, tanks before painting. Six sizes, portable or stationary, from $170.00 and up.



DUST COLLECTING!

Unit Dust Collector stops dust at its source, minimizes machine wear and tear, reduces housekeeping and general maintenance costs. Solves many grinding and polishing nuisances. Reduces material losses. Models from $286.00 and up.



PRECISION FINISHING!

Hydro-Finish Cabinet uses liquid blast, eliminating dust, and reduces costly hand polishing, cleaning and finishing of molds, dies, tools, etc. Removes scale, discoloration and directional grinding lines, prepares surfaces for plating and coating. Holds tolerances to .0001″. Models from $1,410.00 and up.

LOOK TO PANGBORN FOR THE LATEST DEVELOPMENTS IN BLAST CLEANING AND DUST CONTROL EQUIPMENT

Pangborn

MAIL COUPON for full details

(Check for more information)

- ☐ Blast Cleaning Cabinets
- ☐ Blast Cleaning Machines
- ☐ Unit Dust Collectors
- ☐ Hydro-Finish Cabinets

PANGBORN CORP., 1700 Pangborn Blvd., Hagerstown, Md.

Gentlemen: Please send me more information on the equipment I've checked at the left.

Name.....

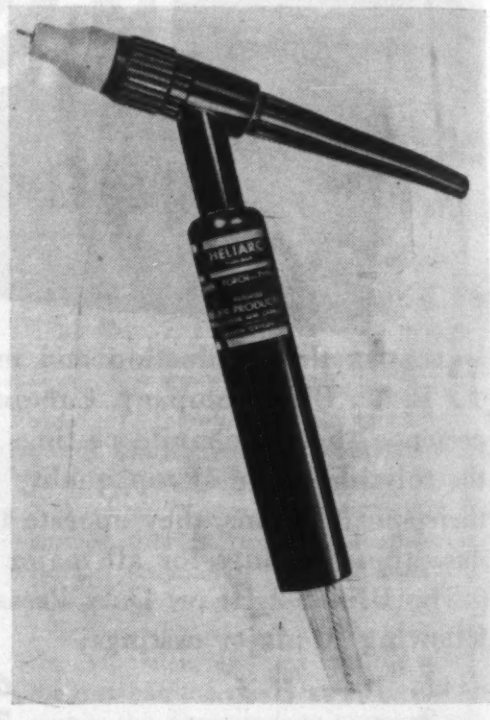
Company.....

Address.....

City.....Zone.....State.....

New Materials and Equipment

ideal corrosion protective undercoat for standard finishes which, in addition to forming an excellent bond between metal and finish coat, has flexibility sufficient to maintain its bonding power and corrosion protection after considerable deformation. One of the prime advantages will be the substantial reduction in the ever-present and critical loss of metallic materials by corrosion during the time between manufacture and use.



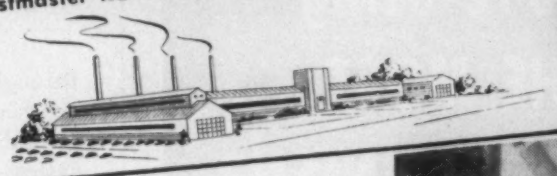
Heliarc Welding Torch for Metals Up to 1/8 in. Thick

A new water-cooled torch for inert gas-shielded arc welding has been announced by *Linde Air Products Co.*, a div. of Union Carbide and Carbon Corp., 30 E. 42nd St., New York 17. The torch has a rated capacity for continuous duty of 300 amp and either high-frequency stabilized alternating current or straight polarity direct current can be used. The new torch, HW-10, is designed for welding practically all commercial metals up to about 1/8 in. thick.

The HW-10 has a torch head and handle assembly weighing only 12 oz. Even if it is used for long periods of time at full rated current, it will not over-heat. Cooling water flows directly into the torch body—there is no outside plumbing. Water is circulated to the torch head,

From Foundry Show at Atlantic City to Riverside Foundry Company's work floor—that's the story of this Pangborn Blastmaster ROTOBLAST Barrel.

Note the signs painted on the machine for the Show are still visible.



Doubles Cleaning Output per man-hour*

with Pangborn Blastmaster ROTOBLAST® Barrel

*at Riverside Foundry Co., Wrightsville, Pennsylvania

The same Pangborn Blastmaster ROTOBLAST Barrel that was the sensation of the 1952 Foundry Show is an even greater sensation on the job! Delivered directly from the floor of Convention Hall to the Riverside Foundry Co., Wrightsville, Pa., the Barrel has already more than doubled the cleaning output per man-hour at this jobbing foundry! And Riverside officials are sold on the high quality of cleaning, the wide range of sizes of castings that can be cleaned, and the absolute abrasive-tightness of the machine.

No matter what you clean—large or small castings, fragile or intricate castings, or any combination—there's a modern ROTOBLAST unit to do a better job for you at far lower cost. Write for details. Ask for Bulletin No. 223 (Blastmaster Barrel) or No. 214 (all ROTOBLAST equipment). Address: PANGBORN CORPORATION, 1700 Pangborn Blvd., Hagerstown, Md.

NEW! Pangborn NEW!
NEW!
THIS NEW PANGBORN ROTOBLAST BARREL FOR BATCH TYPE CLEANING IS ABRASIVE TIGHT
Permits Economical Use of High Quality Modern Abrasives

OVER 28,000 PANGBORN MACHINES SERVING INDUSTRY

Pangborn

Look to Pangborn for the latest developments in Blast Cleaning and Dust Control equipment

BLAST CLEANS CHEAPER

with the right equipment for every job

How ROTOBLAST works for you:

- ***SAVES LABOR*** with push-button operation
- ***SAVES SPACE*** because machines are compact
- ***SAVES TIME*** by cleaning more loads per day
- ***SAVES POWER*** since no compressor is needed
- ***SAVES TOOLS*** because all scale is removed

Are you SURE you're using THE MOST EFFICIENT FINISH?

If your production involves finishing zinc, cadmium, aluminum or cuprous metals, you owe it to yourself . . . and your customers . . . to investigate

IRIDITE®

for on any of these metals Iridite gives you a high performance finish at a low cost from a simple chemical dip.

IF YOU WANT HIGH CORROSION RESISTANCE,
you'll find an Iridite that will meet any military or civilian specifications for chromate finishing.

IF PAINT ADHERENCE IS IMPORTANT,
you'll find Iridite prevents underfilm corrosion and soap formation.

OR, FOR BRIGHT, DECORATIVE FINISHES—

investigate zinc plate and Iridite (Bright) for a chrome-like decorative finish with more corrosion protection than conventional chrome plating . . . or Iridite (Metcote) as a treatment for copper that eliminates the need for buffing in the copper-chrome system; produces a sparkling bright finish!

Write for literature and send us samples for test processing. See "Plating Supplies" in your classified telephone directory or write direct.

Iridite is approved under government specifications.

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Manufacturers of Iridite Finishes
for Corrosion Protection and Paint Systems on Non-Ferrous Metals AND Plating Brighteners

New Materials and Equipment

through the water jacket, back through the head again, and out through the power cable. This improved water-cooling system is said to make possible a design feature that minimizes electrode stub loss. Since the electrode holder is provided with direct water cooling, the collet body is brought closer to the arc without damage from excess heat. With the electrode holder brought down closer to the arc, electrode stub loss is reduced.

Another timesaving feature of the torch is that electrodes can be changed or adjusted in only a few seconds. No wrenches are necessary. A quarter of a turn releases the torch cap and steel collets align new electrodes automatically. Collets are available for 0.040-, 1/16-, 3/32- and 1/8-in. dia. electrodes. Two torch caps are available, permitting the use of either 3-in. or 7-in. electrodes.

Metal gas cups on the HW-10 are conduction-cooled through their threaded connection to the water jacket. They will withstand high welding currents and heavy mechanical abuse without failure. Gas cups can be changed easily without taking the front end of the torch apart.

The entire torch body is sheathed in tough, long-wearing plastic, safeguarding the operator from electrical shock. A plastic material applied to the water jacket prevents arc-flashover between the jacket and the electrical ground.

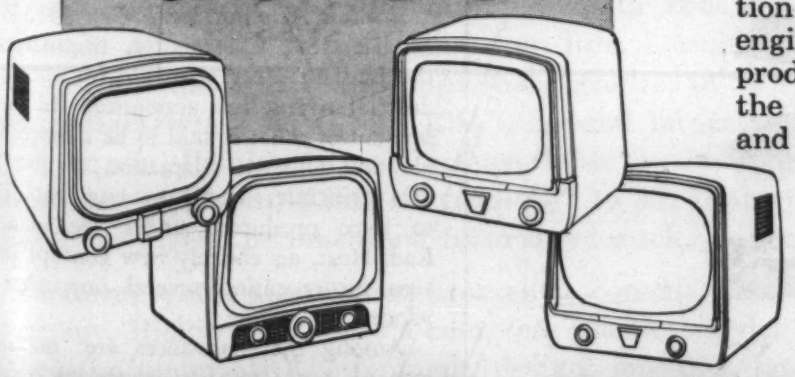
New Tools for Cold Welding

Utica Drop Forge & Tool Corp., Utica 4, N. Y., in cooperation with the *Koldweld Corp.*, New York City, has announced a new device for the welding of nonferrous metals such as aluminum and copper without heat, flame or electrical current and without acids, fluxes or chemicals. In the case of the butt-welding of wires, it is as simple as inserting the two wire ends into a small unit and squeezing plier-like handles.

Unlike conventional welding, in which heat anneals the metal and reduces its tensile strength, Koldwelding is said to actually work-harden the metal. Wire can be drawn after the weld is made, and tensile strengths show that it will ultimately part at some point remote from the weld before the weld itself will fail.

The Koldweld is such that after removal of the small flash of metal at the bond, the connection is the same gage as the wire itself, a great asset where compactness is essential, as in the

Again— **Motorola CHOOSES CHICAGO MOLDED PLASTICS** *FOR 4 NEW CABINETS*



These four brand new models . . . molded of a sturdy phenolic material in rich mahogany with handsome metallic trim . . . are unquestioned style leaders in the new Motorola line. They're big ones, too. The two 21-inch models measure 22½" x 21½" x 21" and weigh 29 lbs. each. The other two are almost as big. And we're turning out hundreds of them every day.

We have molded many different styles and sizes of radio and TV cabinets for Motorola during the past several years. It's rather conclusive evidence, we believe, that Motorola is well sold on plastic cabinets . . . and, specifically, on Chicago Molded Plastics.

Of course, Motorola is just one example. There are dozens of others . . . top names in industry . . . who, year after year, choose Chicago Molded as their primary source of supply. And, why not? They find here a rare combination of experience (more than 32 years of it), top-flight engineers, and the most modern facilities for quantity production of even the largest parts made. It adds up to the best in molded plastics . . . efficiently, intelligently, and economically produced.

Next time you have a job that calls for plastics, talk it over with a Chicago Molded engineer. There's no obligation . . . and you'll thank us for suggesting it. Just write, wire or phone.

CHICAGO MOLDED PRODUCTS CORPORATION

CUSTOM MOLDERS OF ALL *Plastics*

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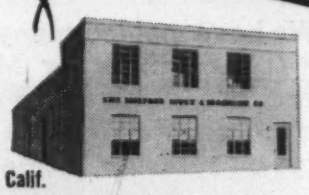
on industry's doorstep to expedite your needs for quality tubular and split rivets, rivet-setting machines and special cold-headed fasteners. Write for an important new brochure, "THE MILFORD METHOD", describing Milford's latest contribution to industrial progress . . . a complete service integrating fastener research, design and engineering with manufacturers' production.



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NEW ENG. DIVISION
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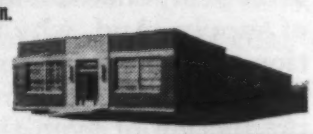

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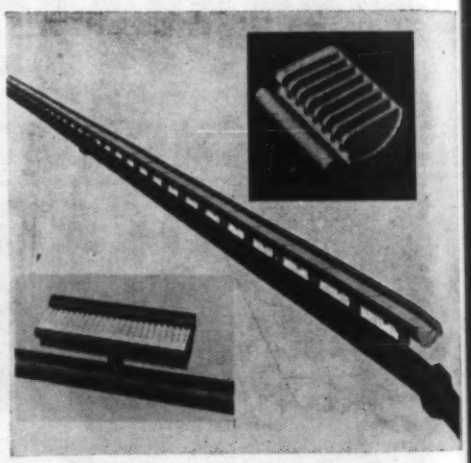
the name to rivet in your memory for fasteners

New Materials and Equipment

manufacture of aluminum stranded cable. In electrical wiring of buildings, the process is said to substantially reduce fire hazard because the joint becomes integral with the wire itself and is not subject to the failure of twisted or coupled joints, and highly efficient spun glass insulation can be applied. In addition to being used for the butt-welding of wire, the process can also be used in joining flat sheets of nonferrous metals. The bond is made solely by pressure.

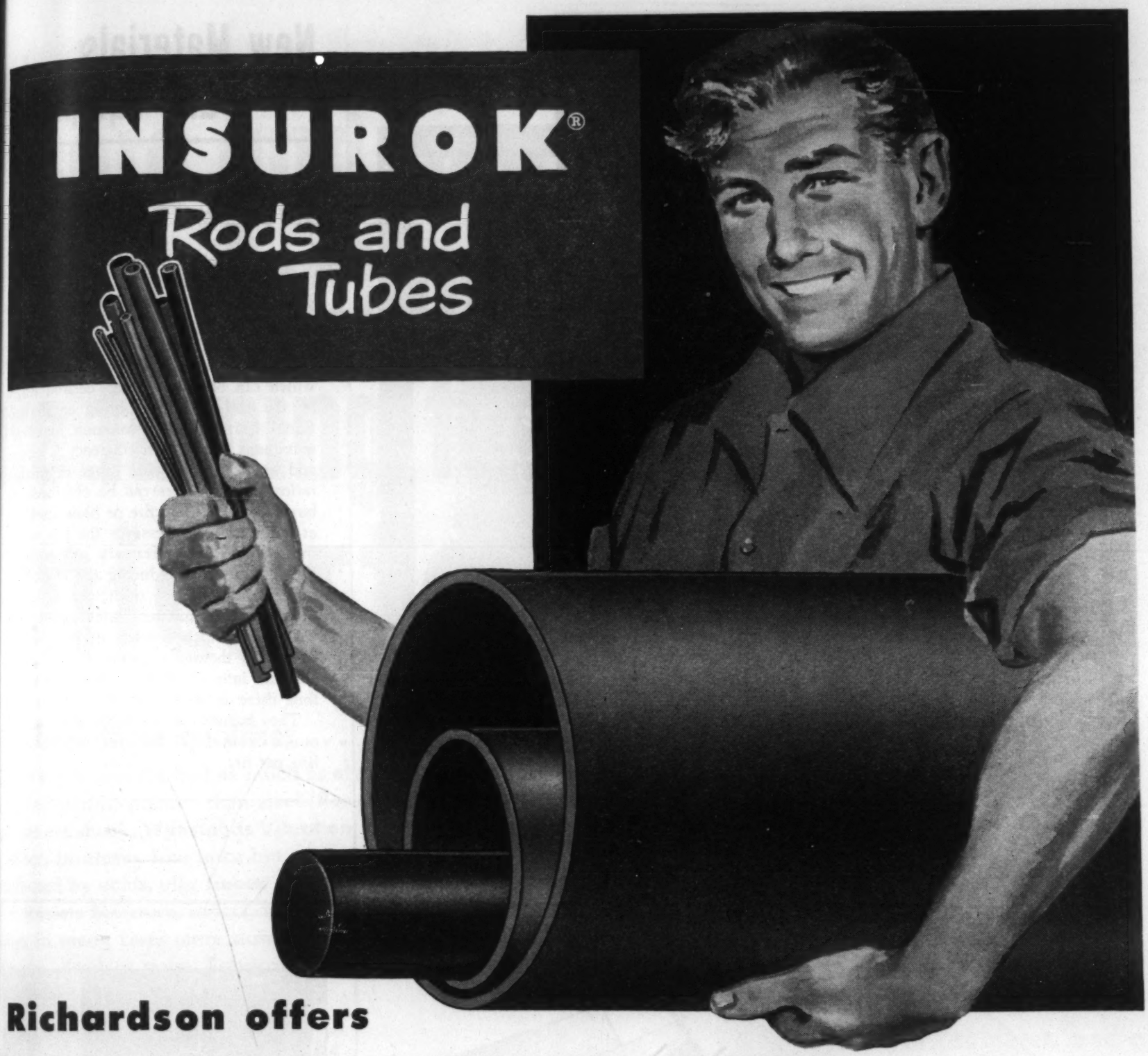
Two devices for accomplishing the Koldweld will soon be in production by Utica. These are the Utica Koldweld tool for wire and the Utica Koldweld tool for sheet. They are compact, easily portable, weigh but a few pounds, and operate basically on the pliers principle.



New Advances in Radiant Heat Industrial Ovens

Burdett Manufacturing Co., 3433 West Madison St., Chicago 24, originators of the Radiant Heat principle for use in industrial ovens, has announced the development of what is said to be a more flexible and efficient adaptation of the Burdett principle. Company engineers claim to have produced, under the name of Radi-Heat, an entirely new concept of design incorporating several important advances.

Among these advances are: maximum rate of heat transfer; complete combustion, with resulting fuel economy; processing time greatly reduced; maximum uniformity of product; and minimum low cost maintenance. It has been stated that the new system can be applied to unlimited applications, with new efficiency and lower cost, such as paint, mold, core, moisture, and other drying operations, as

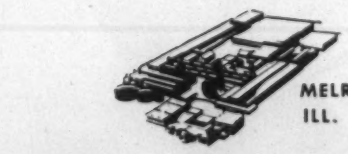


Richardson offers

a complete line of Laminated Plastic Rods and Tubes to meet your needs

You'll find a large range of laminated plastic rods and tubes of various diameters in the Richardson line. Laminated tubes are available in fabric-base and paper-base grades, in 36″ lengths and in diameters from ⅛″ to 12½″. Special larger sizes can be made upon request. Laminated rods are available in molded-paper or fabric-base grades in diameters from ⅛″ to 2″. Diameters from 2″ to 6″ can be machined from sheet stock.

Whatever your plastics requirements, consult The Richardson Company. Richardson offers a *complete* plastics service—embracing materials development, design, molding, laminating, and fabricating. Write for 20-page booklet—"Laminated INSUROK."


MELROSE PARK, ILL.

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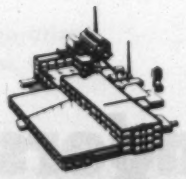
TYLER, TEX.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Heat-Resisting
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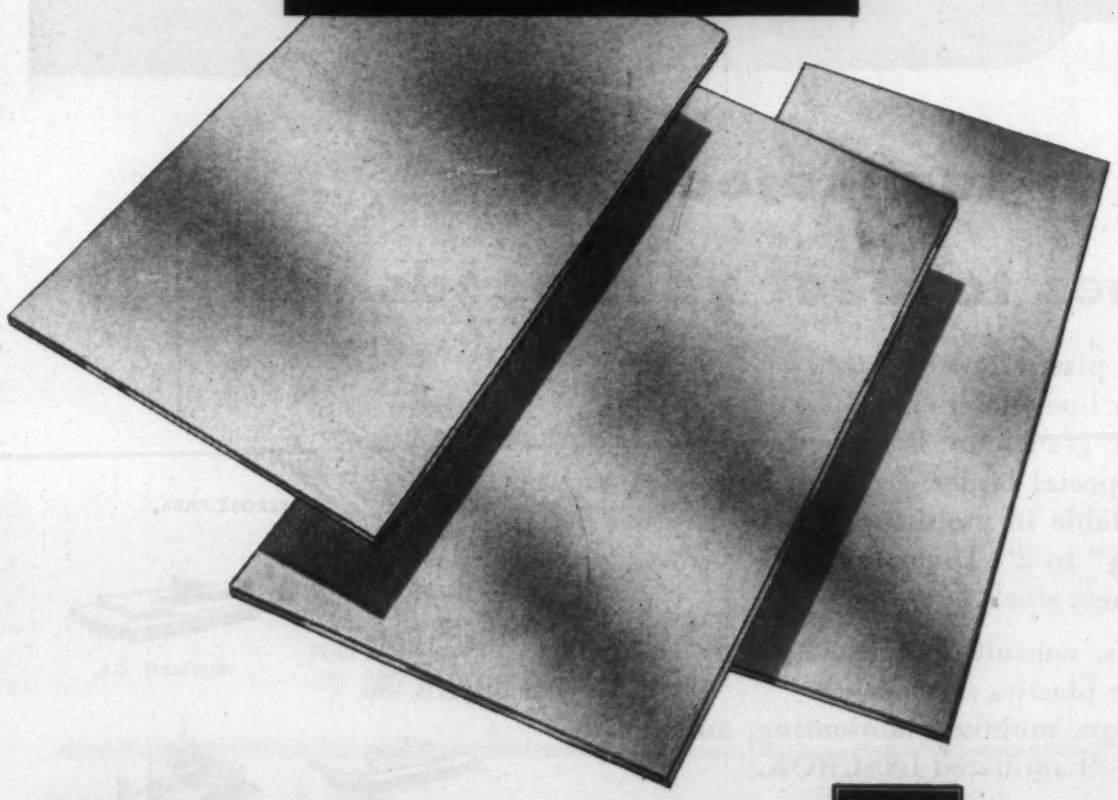


Ingersoll STEEL DIVISION
BORG-WARNER CORPORATION
310 South Michigan Avenue, Chicago 4, Illinois
Plant: New Castle, Indiana

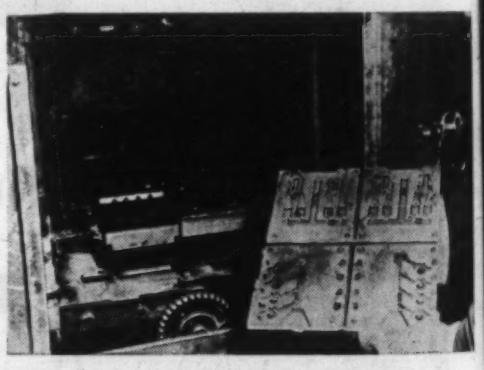
ENGINEERING B-W PRODUCTION

New Materials and Equipment

well as for food processing, plasticizing, heat treating, aging, burn-off, billet heating, cooking, browning, etc.

The following are a few of the advantages which the company believes will widen the scope of its usefulness: the wide fanning radiation of the refractory is accomplished by the open-faced design, which can be used in any desired length by the end-to-end mounting of the sectional burners on a common manifold; maximum combustion efficiency is offered and an extremely wide range of mixture ratios and pressures can be obtained; the burner will not backfire or blow itself out at any manifold pressure; the gas retaining section of refractory gives faster light-up, thereby reducing the amount of raw gas admitted to oven; the design of the burner eliminates fluted or internal baffles on which foreign matter can accumulate; there are no blind milling operations into a totally enclosed chamber, thus there is no possibility of flaws.

The burner is available in capacity ranges from 7000 Btu per hr to 45,000 Btu per hr.



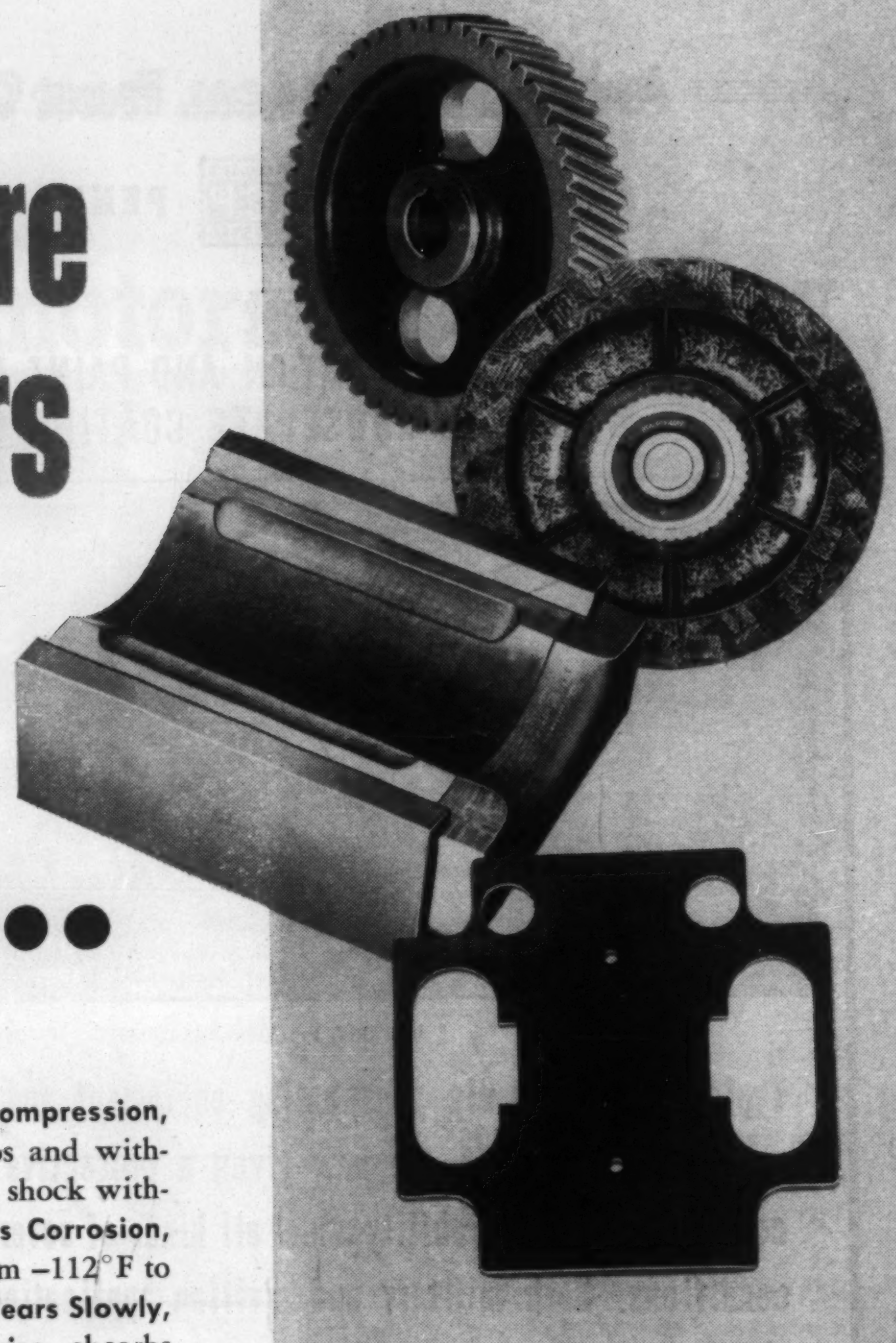
Die-Molding Machine Offered for Shell Molding Process

Powdered Metal Products Corp. of America, 9335 W. Belmont Ave., Franklin Park, Ill., has announced new equipment and procedures for shell molding. The main purpose of the development work was to find practical, economical production processes and equipment for applying the shell mold process. After a number of pilot runs using various methods, a completely automatic machine for turning out approximately 20 complete shells from a single set of dies every hour was developed.

Simple and dependable in operation, the machine is said to perform all steps of the shell molding operation, delivering

re's why...

more and more manufacturers re turning to micarta®...



cause of these qualities...

ves **Weight,** weighs half as much as aluminum. **Resists Compression,** nd for pound greater than steel. **Resists Impact,** absorbs and with-nds severe shock. **Withstands Vibration,** cushions repeated shock with-effect. **Insulates** like mica but greater flexibility. **Resists Corrosion,** affected by acids, oils, fumes. **Resists Heat and Cold** from –112°F to 2°F. **Resists Moisture,** in fact, water is its best lubricant. **Wears Slowly,** enly, in many cases more slowly than metal. **Reduces Noise,** absorbs rations, deadens noise. **Fabricates Easily,** machined or punched with linary tools.

cause of these flexibilities...

minated **MICARTA** includes standard structural shapes: plates, sheets, gles, channels, rods, tubes and zees. Occasionally this class includes nple molded shapes. **Molded MICARTA** is the choice for complicated apes, large production quantities of either simple or complicated apes, or for certain properties better obtainable in form molding.

ecause micarta is basic...

ICARTA is a tough and resilient basic material that welcomes compari-n with other basic materials. This versatile plastic outlasts wood and etal in many punishing applications. Investigate MICARTA and you'll d it the economical solution to tough production problems.

YOU CAN BE SURE...IF IT'S

Westinghouse

micarta

for more information on how MICARTA can help solve your production problems, and give you advantages no metal can give you, please fill out the coupon below. A MICARTA representative will then call on you personally.

mail it today!

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MICARTA Division, Trafford, Pa.
Attention: L. A. Pedley

Sir: (Please Check One)

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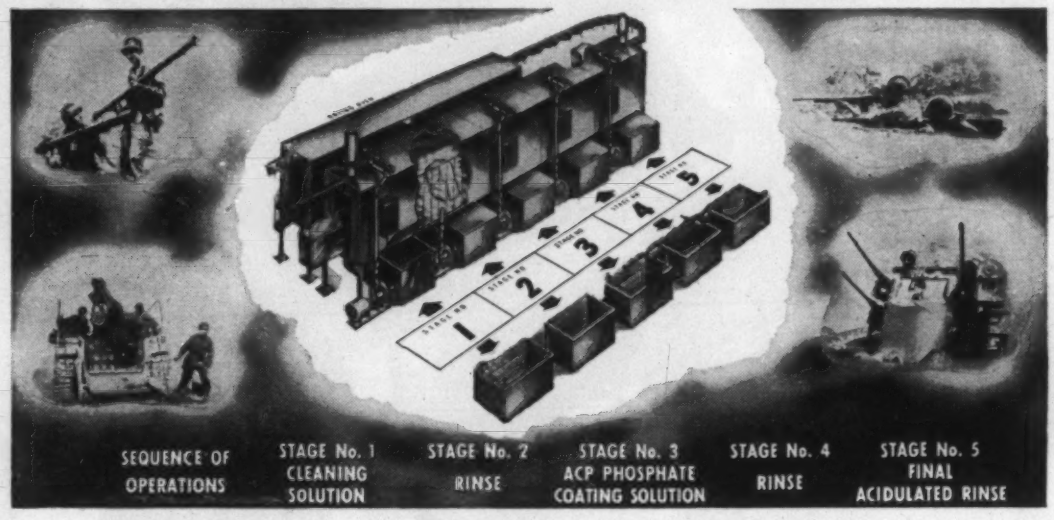
J-06500-E

AMERICAN CHEMICAL PAINT COMPANY

AMBLER CHEMICALS ACP PROCESSES PENNA.

Technical Service Data Sheet
Subject: METAL PRESERVATION AND PAINT PROTECTION WITH ACP PHOSPHATE COATING CHEMICALS


SEQUENCE OF OPERATIONS
STAGE No. 1 CLEANING SOLUTION
STAGE No. 2 RINSE
STAGE No. 3 ACP PHOSPHATE COATING SOLUTION
STAGE No. 4 RINSE
STAGE No. 5 FINAL ACIDULATED RINSE

U.S. ARMY PHOTOGRAPHS COURTESY OF "ORDNANCE MAGAZINE"

Typical spray and dip phosphating equipment and some ordnance products that are now given a protective phosphate coating for extra durability under all kinds of severe exposure conditions. Both military and civilian applications of ACP phosphate coating chemicals are shown in the chart below.

SELECTION CHART OF ACP PROTECTIVE COATING CHEMICALS FOR STEEL, ZINC, AND ALUMINUM

METAL	ACP CHEMICAL	OBJECT OF COATING	TYPICAL METAL PRODUCTS TREATED	GOVERNMENT SPECIFICATIONS
STEEL	"GRANODINE" Zinc Phosphate Coating Chemical	Improved paint adhesion	Steel, iron, or zinc fabricated units or components, automobile bodies, refrigerators, washing machines, cabinets, etc.; projectiles, rockets, bombs, rifles, small arms, belt links, cartridge tanks, vehicular sheet metal, tank bolts and links, recoilless guns, etc.	MIL-S-5002 JAN-C-490, Grade 1 JAN-F-495 U.S.A. 57-0-2, Type II, Class C U.S.A. 51-70-1, Finish 22.02, Class C U.S.A. 50-60-1 16 E4 (Ships)
	"PERMADINE" Zinc Phosphate Coating Chemical	Rust and corrosion prevention	Nuts, bolts, screws, hardware items, tools, guns, cartridge clips, fire control instruments, metallic belt links, steel aircraft parts, certain steel projectiles and many other components.	MIL-C-16232 U.S.A. 57-0-2, Type II, Class B U.S.A. 51-70-1, Finish 22.02, Class B Navy Aeronautical M-364 U.S.A. 72-53 (See An-F-20)
	"THERMOIL-GRANODINE" Manganese-iron Phosphate Coating	Wear-resistance anti-galling, safe break-in of friction or rubbing parts. Rust proofing.	Friction surfaces such as pistons, piston rings, gears, cylinder liners, camshafts, tappets, crankshafts, rocker arms, etc. Small arms, weapon components. Hardware items, etc.	MIL-C-16232 U.S.A. 57-0-2, Type II, Class A U.S.A. 51-70-1, Finish 22.02 Class A Navy Aeronautical M-364 U.S.A. 72-53 (See AN-F-20)
	"GRANODRAW" Zinc-iron Phosphate Coating	Improved drawing, extrusion, and cold forming	Blanks and shells for cold forming, heavy stampings; tubs; tubing for forming or drawing; wire; rod; etc.	———
ALUMINUM	"ALODINE" Protective Coating	Improved paint adhesion and corrosion resistance	Aluminum products of similar design such as refrigerator parts, wall tile, signs, washing machine tubs, etc; aircraft and aircraft parts; bazookas (rocket launchers), helmets, belt buckles, clothes dryers, clothesline, rocket motors, etc., aluminum strip or sheet stock.	MIL-C-5541 (See also QPL-5541-1) MIL-S-5002 AN-F-20 U.S. Navord O.S. 675 16 E4 (Ships) AN-C-170 (See MIL-C-5541) U.S.A. 72-53 (See AN-F-20)
ZINC	"LITHOFORM" Zinc Phosphate Coating Chemical	Improved paint adhesion	Zinc alloy die castings; zinc or cadmium plated sheet or components; hot dip galvanized stock; galvanneal; signs; siding; roofing; galvanized truck bodies; etc.	QQ-P-416 RR-C-82 JAN-F-495 AN-F-20 U.S.N. Appendix 6 U.S.A. 72-53 (See AN-F-20)

CHEMICALS ACP PROCESSES

WRITE FOR DESCRIPTIVE FOLDERS ON THE ABOVE CHEMICALS AND FOR INFORMATION ON YOUR OWN METAL PROTECTION PROBLEMS

CHEMICALS ACP PROCESSES

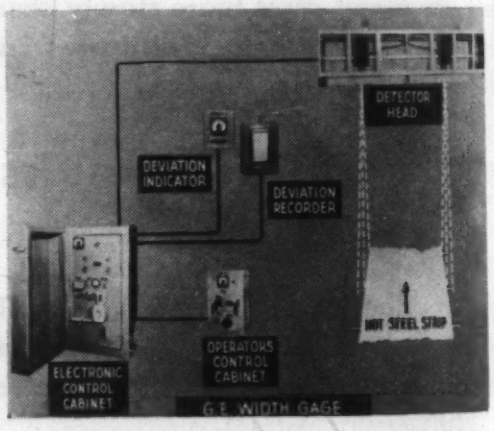
New Materials and Equipment

finished shells ready for pouring or storing. The machine is designed to accommodate dies up to 12 by 18 in.

After dies have been inserted, the sequence of operations performed by the unit is as follows: (1) heat die by means of electrical heating elements inserted in the die shoe; (2) dump mixture of sand and resin on heated die from machine hopper; (3) cure contact surface of the shell by holding the mix in contact with the heated die for a precisely timed interval; (4) rollover to dump excess sand mixtures back into the machine hopper; (5) oven cure the shell to make it permanent; (6) eject completed shell.

The Bachner die-molding machine requires a floor space of about 12 by 6 ft and requires no special foundation. Only about 150 sq ft of floor space would be required for a complete shell molding set-up, exclusive of pouring. 220-v a.c. power is required, together with a compressed air supply.

———

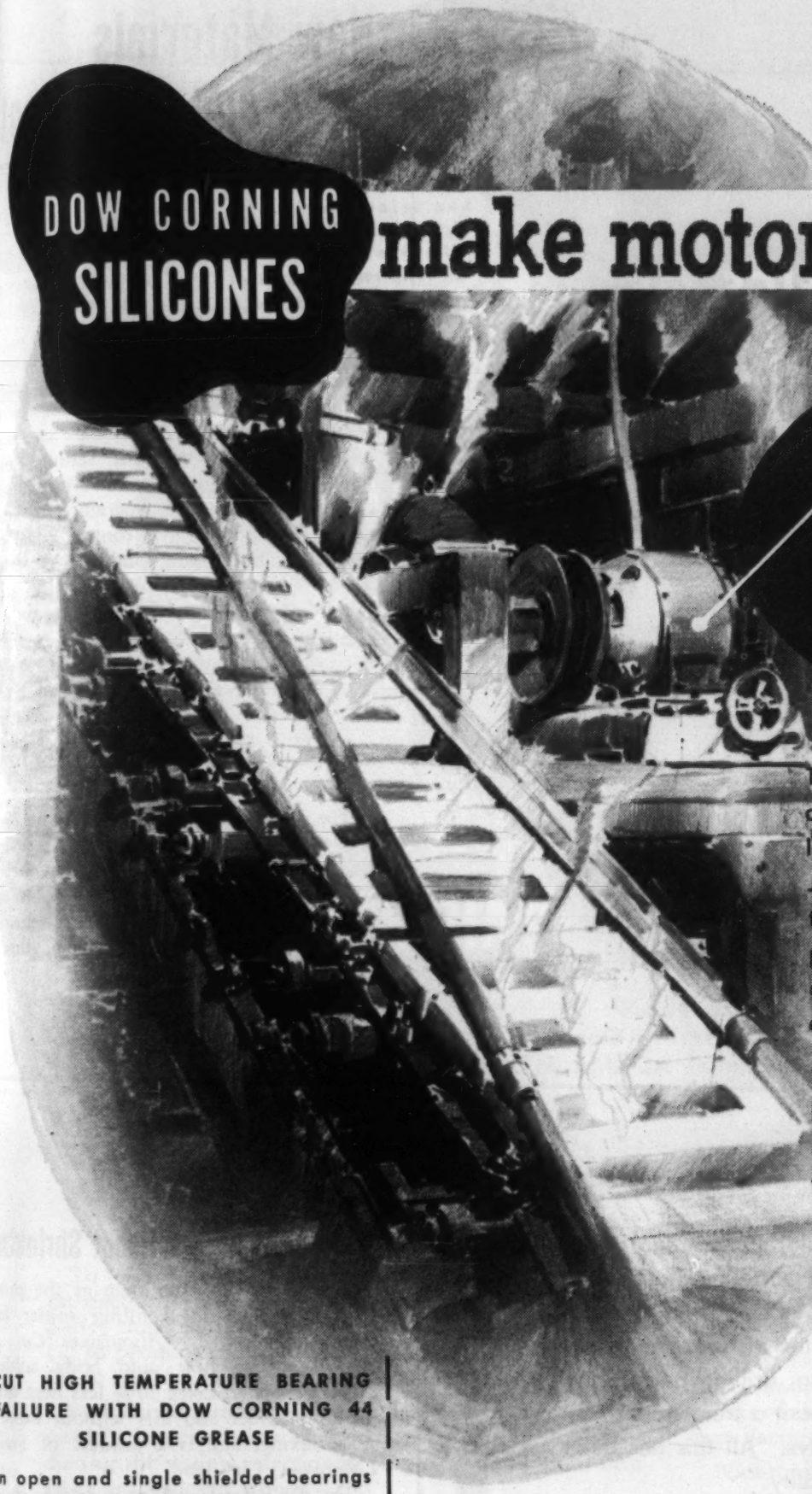


Steel Mill Width Gage

Designed to automatically and continuously measure the width of hot strip steel to an accuracy of plus or minus 1/8-in., the new non-contacting device offered by the Special Products Div, *General Electric Co.*, Schenectady 5, N. Y., is said to be the first equipment of its kind developed. Called the steel mill width gage, it consists of a detector head, an operator's cabinet and an electronic cabinet. Two phototube scanners are located in the gasket-sealed detector head mounted 15 ft above the hot strip steel. They pick up the light radiated from the strip and convert it into signals. The resulting signals are two pulsating square-waves which are each amplified, added

DOW CORNING SILICONES

make motors last longer



Paid for itself 30 times in 2 years

Tough operating conditions are the order of the day for the 5 hp hot-ingot conveyor motor at The Infeld Metals Corporation in Waterbury, Conn. Jogged on a 20-second cycle, it never gets up to speed. An unending procession of freshly-poured ingots at 600° to 2100° F passes within a few feet of it. The quenching system keeps it enveloped in clouds of steam.

The motor used to fail at least every 3 weeks. Rewinding with Class A insulation cost about $109. Down time and lost production expenses were about the same.

Two years ago the motor was rewound by the Electric Motor Repair Company of Waterbury with Dow Corning Silicone (Class H) Insulation. The initial cost was higher—approximately $235—but the motor has not failed since. Based on the 3-week service life of Class A, that means Class H has paid for itself over 30 times, saved $3471 in rewind costs alone.

That kind of performance in thousands of installations has proved that Dow Corning Silicone Insulation has 10 to 100 times the life expectancy of the next best class of insulating materials; increases the power pound ratio in electrical equipment by as much as 50%.

CUT HIGH TEMPERATURE BEARING FAILURE WITH DOW CORNING 44 SILICONE GREASE

In open and single shielded bearings designed for high temperature operation, Dow Corning 44 Silicone Grease has 8 to 10 times the life expectancy of conventional greases. It gives lifetime lubrication in permanently sealed bearings.

mail this coupon Today

Dow Corning Corp., Dept. AF-23, Midland, Mich.
Please send me:
- ☐ Catalog of Class H Insulating Materials.
- ☐ List of Class H motor repair shops.
- ☐ Data on Silicone Grease for motor bearings.
- ☐ 32-page booklet entitled "What's A Silicone?"

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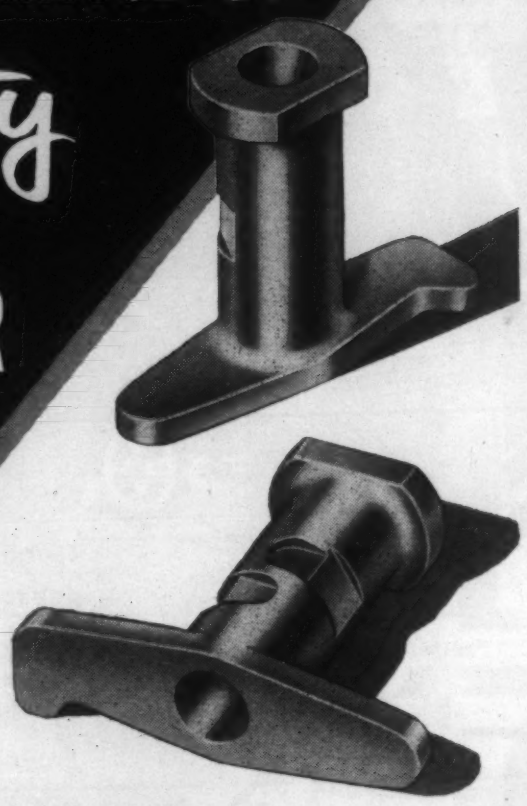

Torque Tube for Gyroscopic Application Investment Cast from S Monel ACTUAL SIZE

Mr. J. B. Lyons* tells us that in the pilot construction stages this torque tube was fabricated in two parts, the flange and the tube and then they were brazed together. Then Hitchiner Precision Investment Castings entered the picture. The resultant saving in turning, profiling, milling, drilling and boring and the elimination of the brazing meant a tremendous saving in cost . . . AND as Mr. Lyons says: "All this has been accomplished without sacrifice of quality."

*Mr. Lyons is Purchasing Agent of the Doelcam Corp., Newton, Mass.

This free folder tells you more about Hitchiner Precision Investment castings . . . send for it today

HITCHINER Manufacturing Company, Inc.
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Representatives in principal cities.

New Materials and Equipment

together, and balanced against a standard voltage so that the difference produces a signal proportional to the width deviation.

The operator's cabinet contains a three-digit mechanical counter which indicates the width for which the gage is set, a deviation indicator, and the necessary controls and switches for setting basic width and making occasional calibration checks. In use, the operator sets the width indicator on the control panel to the width being run, and the detectors are automatically positioned over the strip edges by a motor-driven lead screw.

Strip width of 10 to 96 in. can be measured at temperatures of 1350 to 2050 F and indicated in less than 1 sec after the strip passes under the detector head. Strip position can change as much as 3 in. either vertically or horizontally without affecting the gage accuracy.

The height of the detector head over the strip keeps it away from scale, severe heat, corrosive fumes, and strip cobbles. No changes to the mill or mill table are said to be required. Power requirements are 550 v-amp, 220/440/550 v, three-phase 60-cycle.

New Solder Fills Without Shrinking

A new use for aluminum as the principal ingredient in a filling solder has been announced by *Aluminum Co. of America*. The new auto body solder, called Fil-Soder, takes 50% less heat than tin alloy solder and fills without fluxing or shrinking, and is a product of *Swiss Laboratory*, Cleveland.

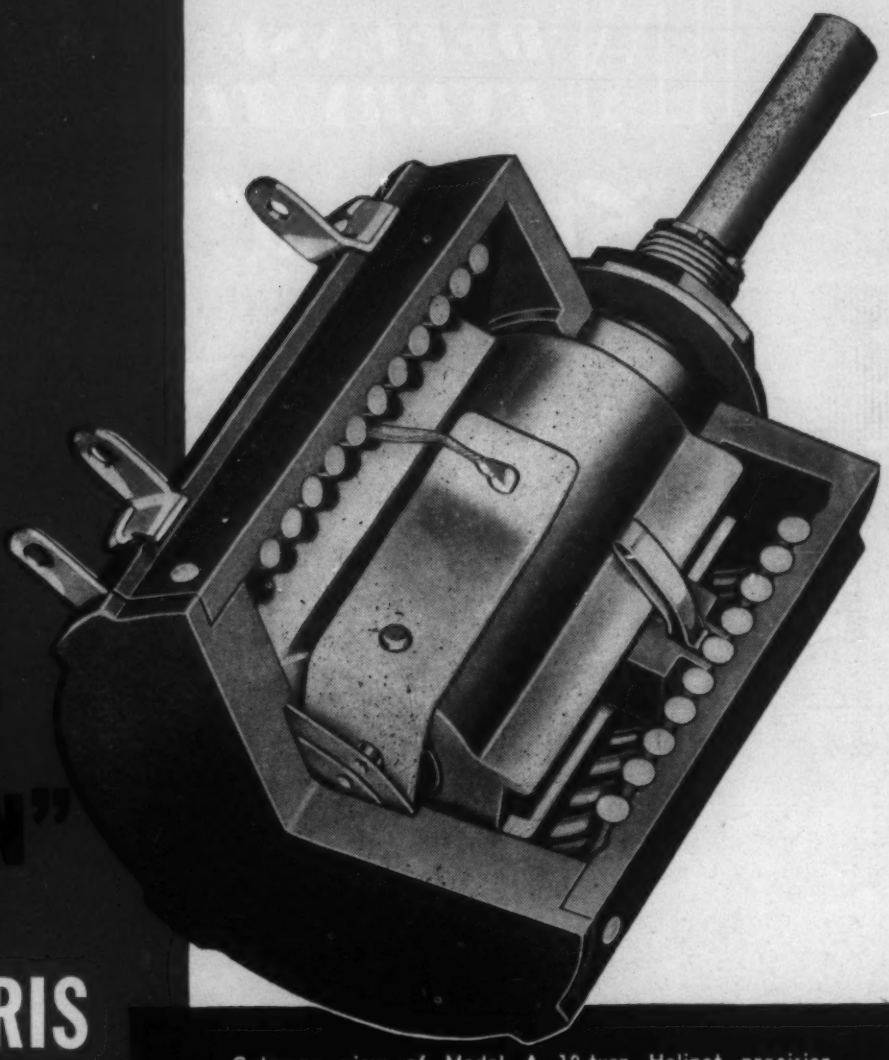
The new type of solder is said to build up fast, stay where it is put, and to keep from running or dripping when working on an upright surface. No new tools or skills are required in its handling, and the solder will stand a 350 F infra-red bake. It will take any finish, lacquer or synthetic. Field tests in garages, body shops and automotive refining shops indicate cost savings in both labor and mateerial. Expected uses are for filling and soldering auto body surfaces, such as bumps and dents on fenders, panels, etc.

With its low melting point, Fil-Soder does not warp the metal, and it feathers to a smooth invisible edge. In addition to its value as a solder for automotive work, it has possibilities as a suitable material for repairing ferrous and nonferrous castings.

Fil-Solder is available in ⅜-in. round

Series AJ Helipot models are only ¾" in diameter and 1⅜" long; weight 1.0 oz. Ten-turn 18" slide wire gives adjustment accuracy of 1/3000 in a 100-ohm unit—1/6500 in a 50,000-ohm unit.

Helipot achieves "HIGHEST PRECISION" with DRIVER-HARRIS RESISTANCE WIRE



Cutaway view of Model A 10-turn Helipot precision helical potentiometer. Resistance element 45" long is contained in case 2" x 1-13/16" diameter. On element are wound 3000 to 9800 turns of resistance wire, depending on total resistance value required. Adjustment accuracy is 12 to 14 times that of conventional single-turn potentiometer of equal diameter.

To win consumer preference and assure customer satisfaction, Helipot Corporation is guided by a basic policy that has proved as effective as it is simple. It is: (1) to produce components of the highest precision, and (2) to realize the economies inherent in mass production.

By following these objectives, Helipot has become the world's largest maker of precision potentiometers, producing the widest selection of single-turn and multi-turn units available anywhere.

States Helipot: "Our policy of mass producing the highest precision potentiometers practicable, in order to deliver top quality at moderate cost, is reflected in the fact that standard linearity accuracy of all our stock models, selling competitively, is held to ±0.5%. Our reliance on Driver-Harris alloys such as Nichrome V, Advance, and Karma to provide resistance windings for many of our products constitutes a strong endorsement of Driver-Harris skills and reliability."

Driver-Harris takes particular pride in having played so important a role in the Helipot story, and is fully conscious of the responsibility the confidence of this famous manufacturer imposes.

Nichrome*, Advance*, and Karma* are at your service, too; as are more than 80 other alloys developed exclusively by Driver-Harris for application in the electrical and electronic fields. We feel confident that, like Helipot, you will realize outstanding advantages by putting one or more of them to work for you. Let us have your specifications. We'll be glad to make recommendations based on your specific requirements.

*T.M. Reg. U.S. Pat. Off.

Sole producers of Nichrome, Advance, and Karma

Driver-Harris Company

HARRISON, NEW JERSEY

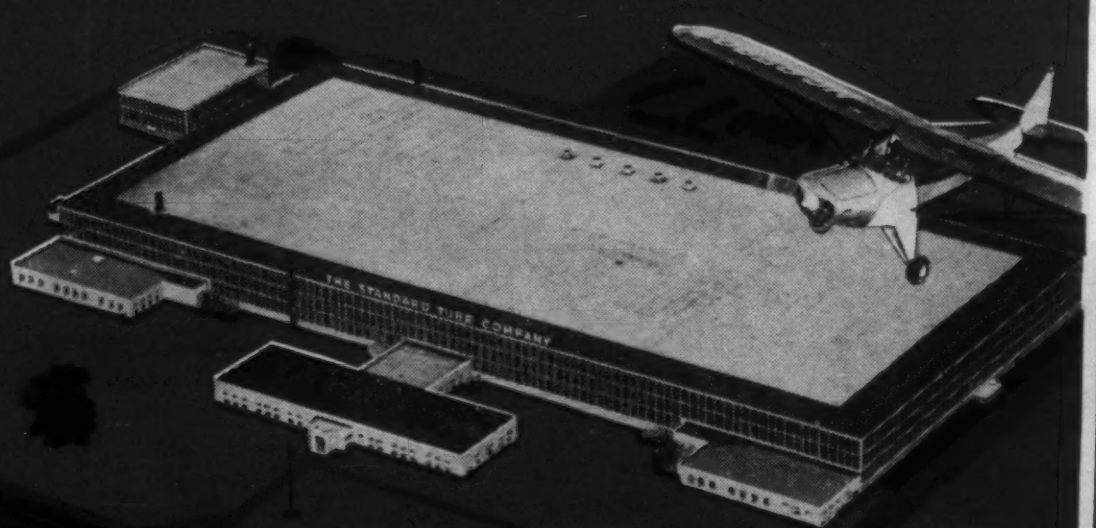
BRANCHES: Chicago, Detroit, Cleveland, Los Angeles, San Francisco

In Canada: The B. GREENING WIRE COMPANY, Ltd., Hamilton, Ontario.

MAKERS OF THE MOST COMPLETE LINE OF ELECTRIC HEATING, RESISTANCE, AND ELECTRONIC ALLOYS IN THE WORLD

IN PEACE TIME
DEFENSE TIME
EVERY TIME

MAKE "Standard" YOUR SOURCE
FOR WELDED TUBING EFFICIENTLY PRODUCED!



Specially Designed
New Modern Plant with
Complete Facilities for Production of:

★ Welded Mechanical ★ Boiler and Heat Exchanger
★ Welded Stainless ★ Exclusive "Rigidized" Patterns

Complete Range of Electric Weld Tubing for
Structural, Mechanical and Pressure Applications

Here in this great new plant are the most modern and complete facilities for the manufacture of Welded Steel and Stainless Steel tubing found anywhere. Let "Standard's" specialists help you!

THE STANDARD TUBE CO.
Detroit 28, Michigan
Welded Tubing
Fabricated Parts
STANDARDIZE with STANDARD — It Pays

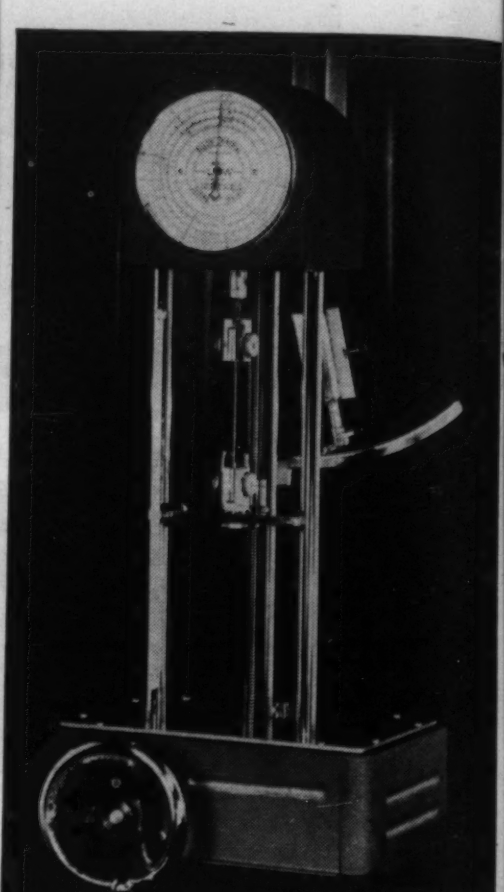
ROUND • SQUARE • RECTANGULAR • SPECIAL SHAPES
Including UPSET • FLARED • FLANGED • TAPERED

★

STEEL TUBING SIZES: ½" O.D. to 5½" O.D. .028 to .260 wall
STAINLESS SIZES: ⅜" O.D. to 3" O.D. .028 to .095 wall

New Materials and Equipment

bars, 12 in. in length. Because of its light weight, 4 oz. of the new product will fill as much space as a pound of other solders.



New Mechanical Tester for Low Ranges

In many test programs, it is desirable to apply a load to specimens with extremely slow speed. This load must be capable of being stopped instantly. A new hand-operated multi-low-range testing machine, offered by *W. C. Dillon & Co., Inc.*, 1421 S. Circle Ave., Forest Park, Ill., is said to serve both of these functions. Further, it offers an important saving in price since it does not require a costly variable speed drive or other electrical controls.

Accuracy of the tester is guaranteed to within ½ of 1% to meet ASTM requirements. The unit employs a pendulum type mechanism set in carefully machined bearings. A set of gripping fixtures for flat specimens up to ⅛-in. thick by 1¼ in. wide is included with each unit. These can be quickly removed and replaced with a wide variety of other stand-

AMERICAN FELT FOR SEALS

American supplies special felts for seals. These are ideal materials for bearings, rotating shafts, housings, and similar applications. In many cases, such seals provide lubrication, and no attention is required between major overhauls. Lifetime sealing for ball bearings is another important application. For full information, write for Data Sheet No. 11, "Felt Seals, Their Design and Application." And remember, there are 15 other mechanical functions which felt can perform in your plant or product.

American Felt Company
TRADE MARK

GENERAL OFFICES: 24 GLENVILLE ROAD, GLENVILLE, CONN.
SALES OFFICES: New York, Boston, Chicago, Detroit, Cleveland, Rochester, Philadelphia, St. Louis, Atlanta, Dallas, San Francisco, Los Angeles, Portland, Seattle, San Diego, Montreal.—PLANTS: Glenville, Conn.; Franklin, Mass.; Newburgh, N. Y.; Detroit, Mich.; Westerly, R. I.—ENGINEERING AND RESEARCH LABORATORIES: Glenville, Conn.

WHEELABRATOR®

AIRLESS BLAST CLEANING RETURNS INVESTMENT IN LESS THAN ONE YEAR

for JOHNSON *"Sea-Horse"* motors

☆ REDUCED POROSITY

☆ IMPROVED FINAL FINISHING

☆ LESS HAND POLISHING

☆ INVESTMENT RETURNED IN 10 MONTHS

New, informative book gives complete, concise information on all phases of airless blast cleaning. Write today for Catalog No. 74-A.

At the Johnson Motor Division, Waukegan, Illinois, two Wheelabrator machines not only returned the entire cost of the equipment, but also made a 25% profit on the investment . . . in one year.

At the same time "Wheelabrating" has provided these extra benefits: Finishing operations on aluminum die castings have been improved by providing a more uniform surface; at least 40% of the porous castings that would have been "leakers" now pass the water test after shot peening; minor imperfections which previously required hand buffing are now removed, with the result that polishing takes less labor time and paint adheres more firmly; many of the smaller burrs and flash are removed, which greatly reduces the cost of manual deburring.

Benefits like these are too important to overlook . . . perhaps the Wheelabrator can do the same for you . . . why not investigate it soon?

American

WHEELABRATOR & EQUIPMENT CORP.

538 S. Byrkit St., Mishawaka 5, Ind.

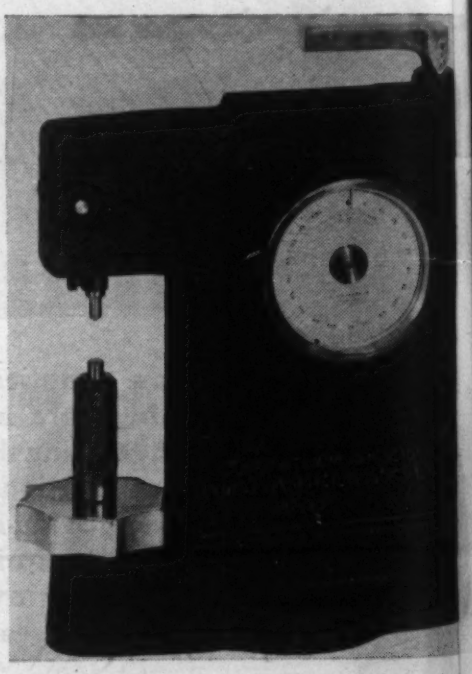
WORLD'S LARGEST BUILDERS OF AIRLESS BLAST EQUIPMENT

New Materials and Equipmen

ard grips which are available for wi paper, wood, adhesives, rubber, spring etc. Elongation readings are provid by means of a special elongation sca and traveling hair line affixed to the mo ing platen. Tests can be made in tensil compression, transverse and shear.

The instrument is available with t following grip clearances: 14¾, 24, and 48 in. The basic dial is calibrat with four individual scales broken dow as follows: 10-lb range with ½-lb d visions; 25-lb range with 1-lb division 50-lb range with 2-lb divisions; 100- range with 5-lb divisions. A supplemen tary dial is available calibrated for 0-3 lb with 1-lb divisions.

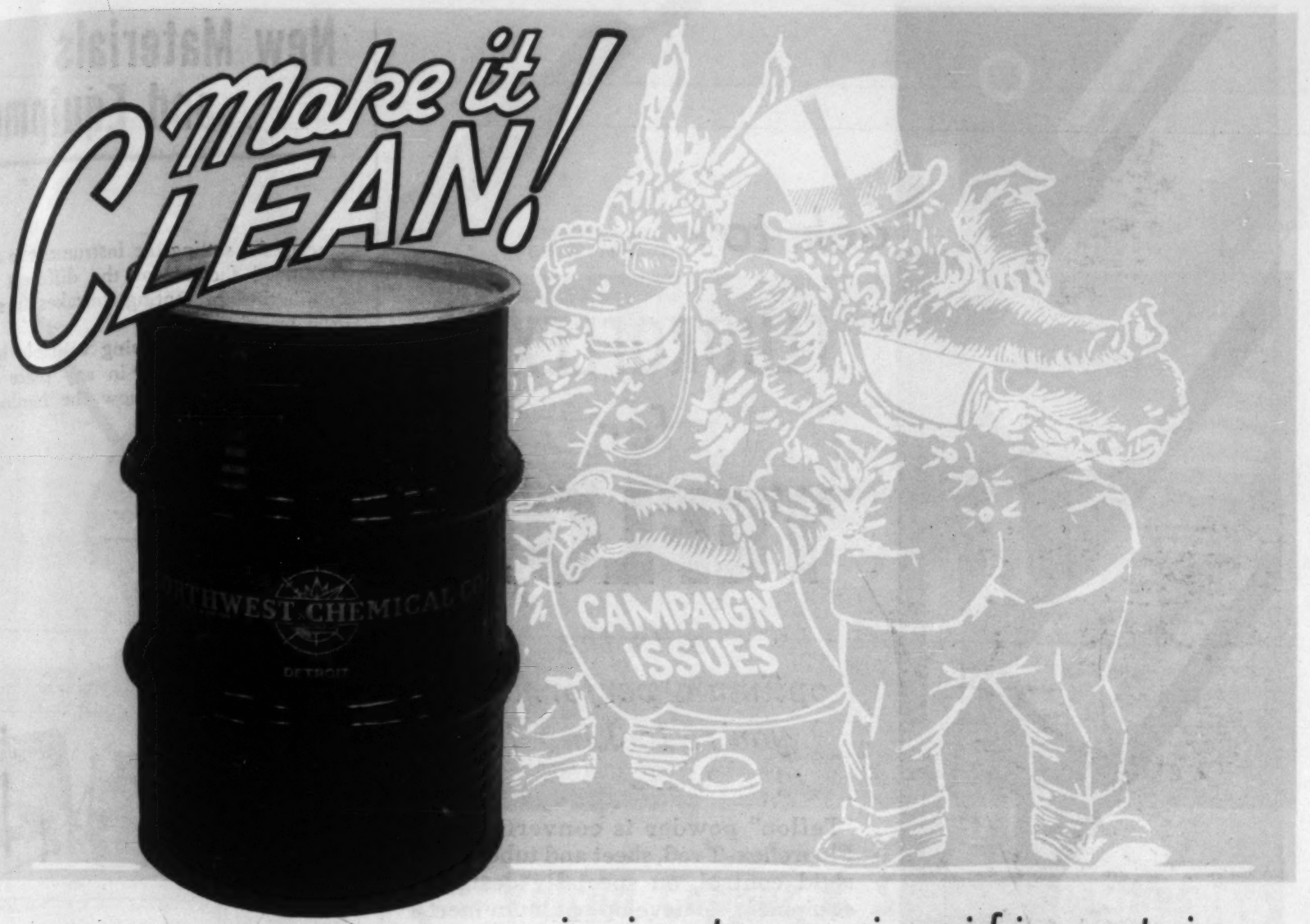
Overall height is 64 in. The entire a sembly is finished in polished chromiu and hammered gray enamel baked o Maximum readings are easily obtain since the pointer remains at peak lo after a specimen breaks. It is reset simply releasing the pendulum pawls.



Improved Hardness Tester Offer

A 3-in. capacity hardness testing u offering several improved features, been announced by *J. P. Newman C* 821 S. Raymond Ave., Alhambra, Ca Said to be outstanding is the addition the A and D scales to the already existi C-B and E scales. This feature enab the operator to test very thin sheet ste whereas with the C scale the major lo is too great for thin stock.

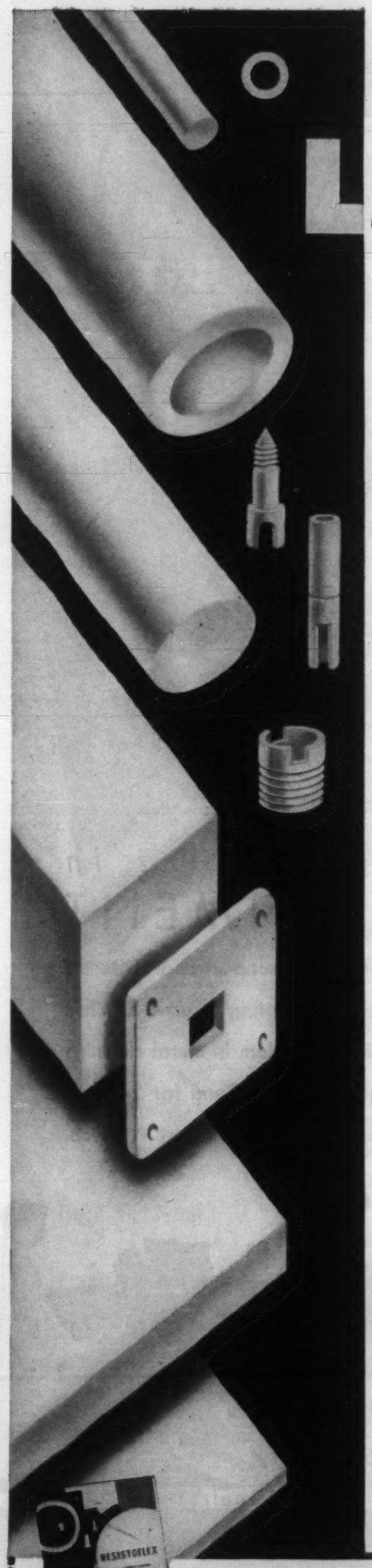
Another improvement is the visio



...is just as significant in

INDUSTRY as it is in GOVERNMENT

We have elected new political leaders. We hope they do well by "Old Uncle Sam." Northwest Chemical Co. has received votes of confidence from many of you for nearly twenty years. Our platform has not been "New Deal" or "Old Deal" but a Good CLEAN Deal. On this basis we solicit your continued support and invite the support of you who have been voting otherwise. When next you are faced with a problem in metal cleaning let us show you what we can do. Send for 24-page brochure that describes all the Northwest Products.



Look to

FLUOROFLEX†-T

for

TEFLON*

with the optimum performance you're looking for

"Teflon" powder is converted into Fluoroflex-T rod, sheet and tube under rigid control, on specially designed equipment, to develop optimum inertness and stability in this material. You can be sure of ideal, low loss insulation for uhf and microwave applications..., components which are impervious to virtually every known chemical...and serviceability through temperatures from −90°F to +500°F.

Produced in *uniform* diameters, Fluoroflex-T rods feed properly in automatic screw machines without the costly time and material waste of centerless grinding. Tubes are concentric—permitting easier boring and reaming. Parts are free from internal strain, cracks, or porosity. This means fewer rejects, longer service life.

Mail in the coupon for more data.

**Du Pont trade mark for its tetrafluoroethylene resin. †Fluoroflex is a Resistoflex registered trade mark for products made from fluorocarbon resins.*

RESISTOFLEX

RESISTOFLEX CORPORATION, Belleville 9, N. J. M-11

SEND NEW BULLETIN containing technical data and information on Fluoroflex-T

NAME.....TITLE.....

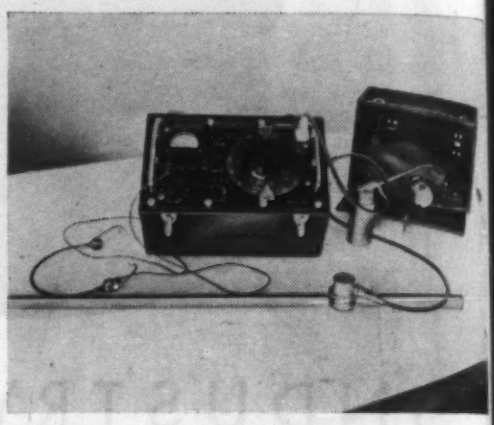
COMPANY.....

ADDRESS.....

New Materials and Equipment

means for setting the instrument to different load factors for the different scales used, thus preventing mistakes in setting the machine.

The tester is proving valuable in tool and press rooms or in any place where it is desirable to know the hardness of metals.



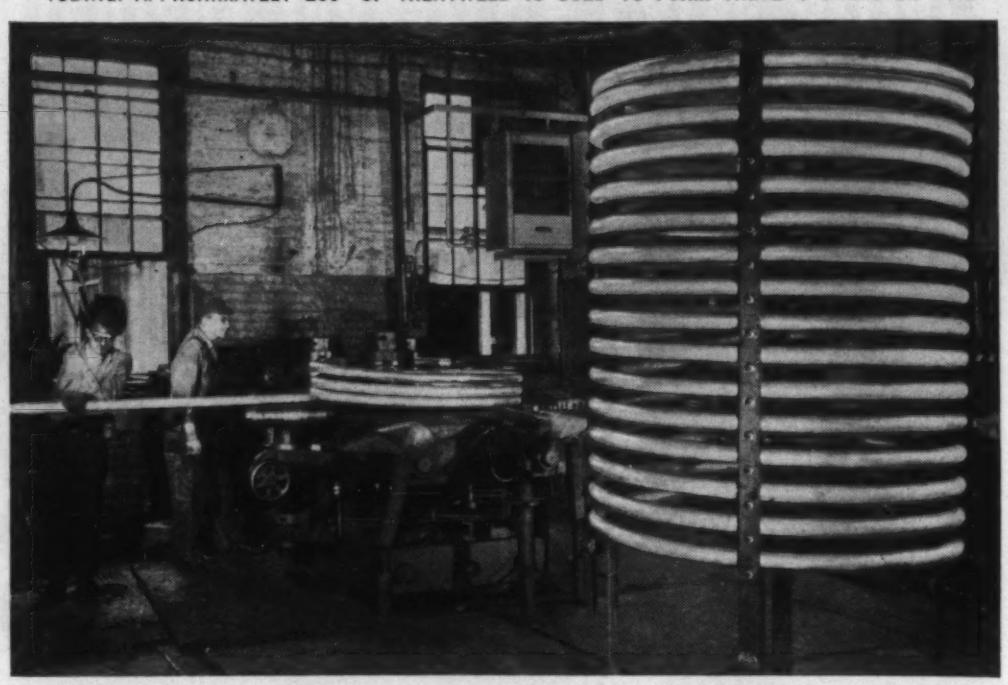
Precision of Ultrasonic Micrometer Improved

Ultrasonic thickness measurements can now be made with a precision substantially higher than has previously been possible, according to *Branson Instruments, Inc.*, 430 Fairfield Ave., Stamford, Conn. The company has developed a new ultrasonic micrometer, Audigage, from which measurements consistently within ½ of 1% of actual thickness have been obtained from one side of materials with smooth surfaces. The instrument can be used on homogeneous materials such as steel, brass, aluminum, copper, glass, lucite and other dense substances capable of transmitting the ultrasonic waves generated by a vibrating crystal.

The unit measures thicknesses by determining the frequency at which resonance of the high-frequency sound waves occurs in the material under test. Resonance is indicated by maximum deflection of a meter and maximum strength of a tone audible in the headphones. Since accuracy, rather than rough checking, is the primary objective of the micrometer, it is designed to operate with high precision over an infinite series of relatively narrow thickness ranges between 0.010 and 12 in. Plug-in frequency coils and matched dials for any desired frequency, both of which are readily interchangeable without disassembly of the instrument, permit the selection of the one specific

VULCAN COOLERS FOR FERMENTATION INDUSTRIES

CONDENSER COILS BEING COLD-FORMED FROM 2″ TRENTWELD STAINLESS STEEL (TYPE 317) TUBING. APPROXIMATELY 205′ OF TRENTWELD IS USED TO FORM THESE 4′-DIAMETER COILS.



Vulcan Copper & Supply specifies

TRENTWELD...

for condenser coil and coolers

Vulcan Copper & Supply, big name engineers and manufacturers of distillation, evaporation and extraction equipment . . . is another of the many manufacturers of process industry equipment who use TRENTWELD Stainless Steel Tubing.

And it's no wonder! TRENTWELD Stainless Steel Tubing is made in a *tube* mill by *tube* experts . . . and TRENTWELD is machine-formed, machine-welded for uniformity. Then too, our manufacturing methods and modern facilities permit us to supply TRENTWELD in tube sizes from ⅛″ to 40″ diameter.

You get fast service! We're conveniently located to deliver quality TRENTWELD *on time!* Whatever your industry, there's TRENTWELD Tubing to fit your design. Write us full details.

TRENTWELD

STAINLESS STEEL TUBING

TRENT TUBE COMPANY, GENERAL SALES OFFICES, EAST TROY, WISCONSIN (Subsidiary of CRUCIBLE STEEL COMPANY OF AMERICA)

The U. S. Steel Supply team

that gives you

personalized service

These people *specialize* in good steel service!

GOOD STEEL SERVICE is much more than a one-man job . . . it requires teamwork between specialists. Each of our warehouses has such a team ready to go to work to give you fast, trouble-free service.

Your U. S. Steel Supply salesman will put the members of this team to work for you. Call him for steel, tools, equipment, machinery, advice on the selection of the right type of steel, or assistance on production techniques with special steels. United States Steel Supply is a "one call" source of steel supply service . . . one call to our salesman puts an expert team to work to see that you get what you want—where you want it—when you want it.

YOUR "ONE CALL" SOURCE OF STEEL SERVICE

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UNITED STATES STEEL SUPPLY DIVISION, UNITED STATES STEEL COMPANY
HEADQUARTERS: 208 So. LA SALLE ST., CHICAGO 4, ILL. · WAREHOUSES COAST-TO-COAST
Warehouses and Sales Offices: BALTIMORE · BOSTON · CHICAGO · CLEVELAND · LOS ANGELES · MILWAUKEE
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UNITED STATES STEEL

New Materials and Equipment

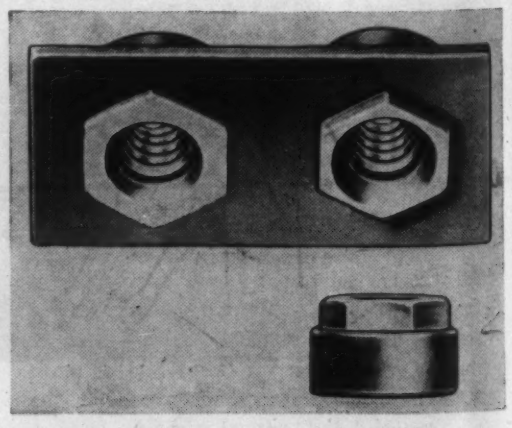
frequency best suited to the required thickness range.

Since the instrument accommodates two coils at once and each dial has provision for two scales, the user has two thickness ranges at his command at all times by simply turning the range-selector control. Scales can be computed either for direct reading or to show deviations from any standard thickness desired.

New Cleaner for Aluminum and Tin Offered

Oakite Products, Inc., 19 Rector St., New York 6, has announced the development of Oakite Composition No. 80-A, a material designed for use wherever an excellent cleaner offering a high degree of safety to aluminum, tin or other soft metals is required.

According to the company, the cleaner has wide applications on a broad variety of work in aircraft and metal plants where exceptional cleaning ability and thorough safety in use are essential. The materials can be used in soak tank or pressure spray washing machines; it is readily soluble in hot water, and rinses easily with hot or cold water.



Fastener Designed for Blind Assemblies

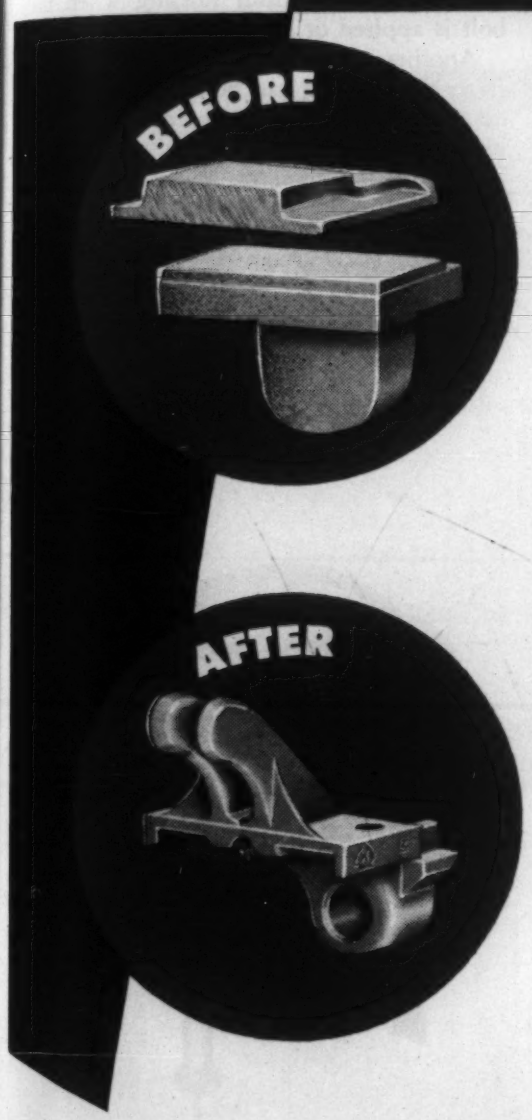
Recommended for blind assemblies or to furnish additional threading depth for application of bolts in thin metals, the Gripco Clinch nut currently being offered by *Grip Nut Co.*, S. Michigan Ave., Chi-

PRECISION FROM

KIOWA

PRINT TO PRODUCT

Tightens Industry's Purse Strings



Through the years, Kiowa Corporation has maintained an outstanding record among Mid-western industry . . . the result of Kiowa's continuous assistance in helping industry meet its greatest objective. MORE PRODUCTION IN LESS TIME FOR LESS MONEY.

A striking example of Kiowa thriftiness can be seen in the recent assignment for the LeFebure Corporation of Cedar Rapids, Iowa.

If you're economy-minded (and who isn't!) put Kiowa on your production team today!

The two aluminum sand castings at the left, part of a LeFebure tray-binder, were redesigned by Kiowa into a simplified zinc-base die casting. Holes were drilled and tapped and the part readied for assembly, prior to shipment.

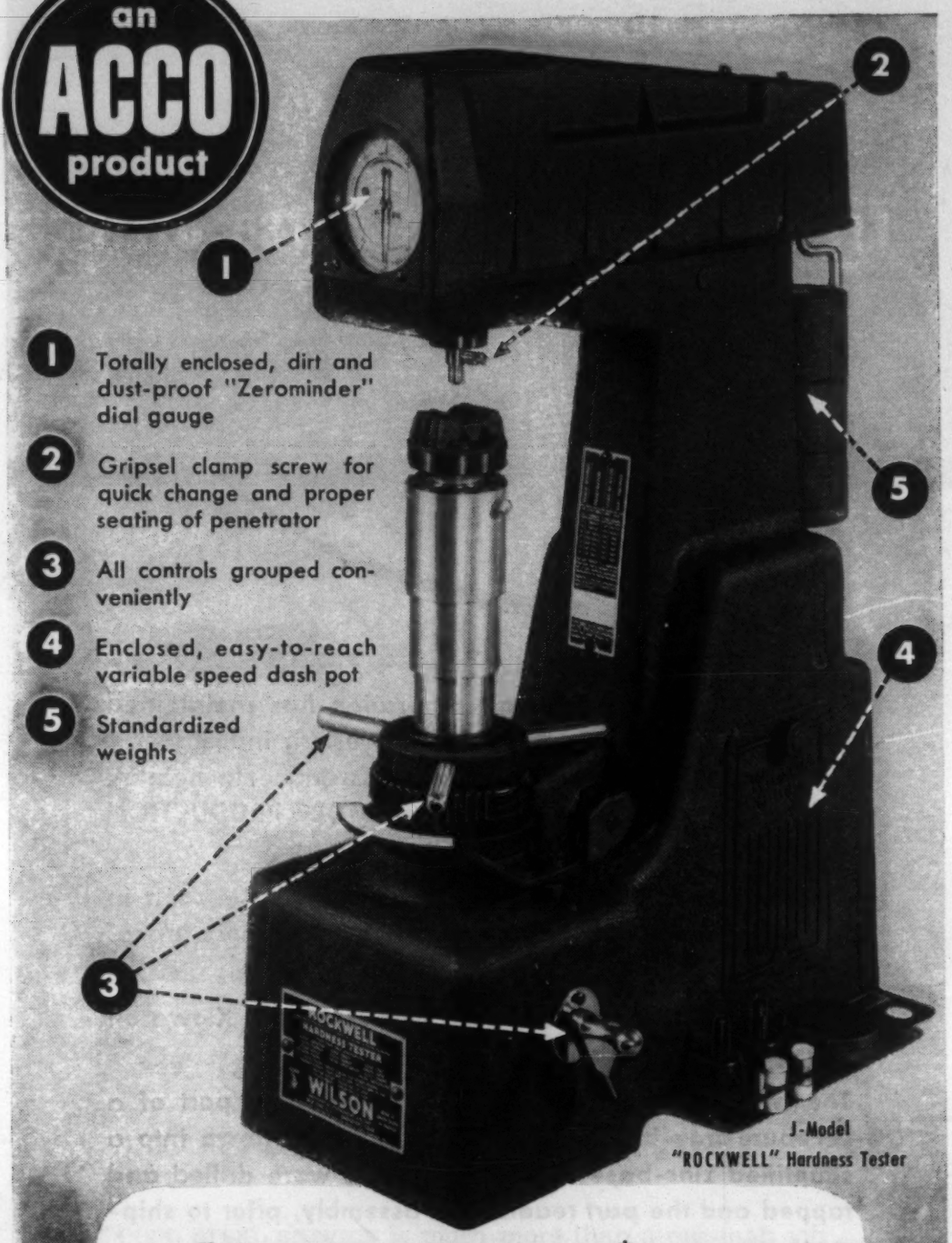
The tremendous savings effected by the redesign are evident in each of the many production phases. Fewer parts, less time and labor required per finished unit; smaller inventory of parts to be bought, stored and expedited to production assembly points, and fewer functional failures as a result of less opportunity for human error in assembly.

- **Zinc Base Die Castings**
- **Brass, Bronze, Aluminum Sand Castings**
- **Aluminum Gravity Die Castings**

KIOWA CORPORATION 25TH ANNIVERSARY

KIOWA CORPORATION

an ACCO product



1 Totally enclosed, dirt and dust-proof "Zerominder" dial gauge

2 Gripsel clamp screw for quick change and proper seating of penetrator

3 All controls grouped conveniently

4 Enclosed, easy-to-reach variable speed dash pot

5 Standardized weights

J-Model "ROCKWELL" Hardness Tester

5 Important "ROCKWELL"* Features

You can be *sure* of the hardness of incoming metals and the various parts or products you ship to your customers if you use a WILSON "ROCKWELL" Hardness Tester. Only in the WILSON will you find these five important features which assure accuracy and ease of operation.

There are two types of WILSON "ROCKWELL" Hardness Testers . . . Regular and Superficial. They come in many styles with accessories for testing flats, rods, rounds, and odd shapes. For micro-indentation hardness testing, there is the WILSON TUKON.

Write for information and let us make recommendations.

*Trade Mark Registered

ACCO

WILSON MECHANICAL INSTRUMENT DIVISION
AMERICAN CHAIN & CABLE

230-E Park Avenue, New York 17, N. Y.

WILSON "ROCKWELL" and TUKON Hardness Testers

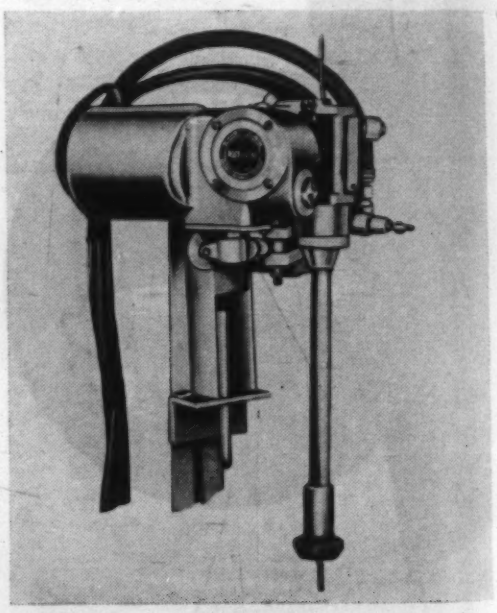
New Materials and Equipment

cago 4, is said to have important advantages over other types of fasteners.

The nut is round with a hexagon-shaped pilot which fits snugly into a hexagon shaped hole in the metal to which it is being applied. The pilot is then pressed down and flattened out, clinching the nut securely into the hexagon hole. The hexagon pilot in the hole prevents the nut from turning when the bolt is applied or removed.

Another advantage claimed for the fastener is that it can be applied after the mating parts have been painted or enameled. This avoids trouble with paint otherwise deposited on the nut threads.

The fasteners can be used on aluminum, brass or other metals which cannot be projection welded, and they are available with standard threads or with Gripco deflected locking threads.

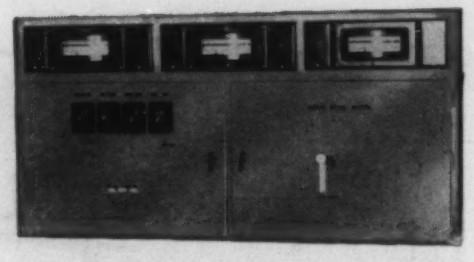


Equipment Replaces Galvanized Surface on Butt Welded Parts

The *Metallizing Co. of America*, 3520 W. Carroll Ave., Chicago 24, has developed a process for recoating the galvanized finish burned off in the butt-weld operation. This equipment, which attaches to the forming and butt-welding machine, costs less than $2000, installed. It stops and starts with the welding and forming equipment and is positive in application.

The speed of replacing the coating is set to conform with the forming and welding equipment. The average is 100 ft per min, but this can be greatly increased or decreased to correspond with manufacturing speeds.

Although this covers only round tubing



Three-zone temperature control

the SURE KEY to higher plastics production

the W-S 16 OUNCE HORIZONTAL MOLDING MACHINE

Experience has shown that the day-to-day shirt-sleeve jobs are done most economically on the intermediate size machines—notably the famous W-S 16 ounce Injection Molder.

There's more than size, however, behind the outstanding preference for this model. Consider, for example, a single machine in which *all* these features are offered:

- Extra long heating cylinder for increased plasticizing efficiency . . . COMPARE!
- Three-zone temperature control . . . COMPARE!
- Replaceable bronze bushings in cylinder and moving platens...COMPARE!
- Faster cycles with dual pressure controls . . . COMPARE!
- Hydraulic and electric safety controls . . . COMPARE!
- Special pumping unit . . . COMPARE!
- Remote control panel . . . COMPARE!

If *your* profits are coming in something less than the full measure, it will pay you handsomely to investigate this profit-booster NOW. Detailed literature and/or personal analysis without obligation.

W-S HYDRAULIC

HYDRAULIC MACHINERY DIVISION

162 Aldene Rd.

ROSELLE, NEW JERSEY

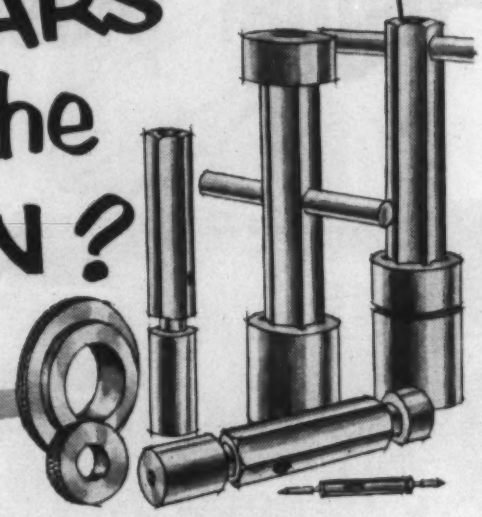
WATSON-STILLMAN

ESTABLISHED 1848

9-M-74

Foreign Sales Representatives: OMNI PRODUCTS CORP., 460 Fourth Ave., New York 16, N. Y.
Correspondents Throughout the World

Are you throwing THOUSANDS OF DOLLARS into the SCRAP BIN?



You can now chrome plate worn gages *IN YOUR OWN SHOP*

This compact new chrome plating unit is saving real money for leading engineering and manufacturing concerns throughout the country. For instance, here's what Taller and Cooper, Inc., foremost makers of toll collection equipment and builders of electro-mechanical measuring and recording devices, say about their Chromaster installation:

"Within one hour from the time a space was arranged for the unit, the Chromaster was in operation. In the very first day over $100.00 worth of undersize plug gages that normally would have been discarded were replated and put back in use in our inspection department."

Same saving applies to other small tools

Normal life of your cutting tools and wear parts can be multiplied 3 to 10 times by this accurate, simplified method of chrome plating right in your own shop. Chromaster deposits chrome with positive uniformity yet the average job takes only 3½ minutes.

Chromaster

Write for cost-cutting free information today!

A Chromaster for every shop

Model A-20 (shown here) is a 20-amp, bench-mounted unit for the gage room or tool crib; plates up to 10 sq. in.

Model A-50, 50-amp, bench-mounted unit for larger shops in plating of cutting tools. Plates up to 25 sq. in.

Model A-250, 250-amp, floor-mounted unit for production plating of small parts in greater quantities or larger parts with areas up to 125 sq. in.

Industrial Chrome Division
Ward Leonard Electric Co.
16 South Street,
Mount Vernon, N. Y.

Please send me complete information on Chromaster industrial chrome plating

NAME.....

COMPANY.....

ADDRESS.....

CITY.....ZONE....STATE.....

New Materials and Equipment

and containers, the manufacturer may find it adaptable to many other applications where it is desirable to fabricate from galvanized material.

Mechanical "Eye" Detects Surface Flaws

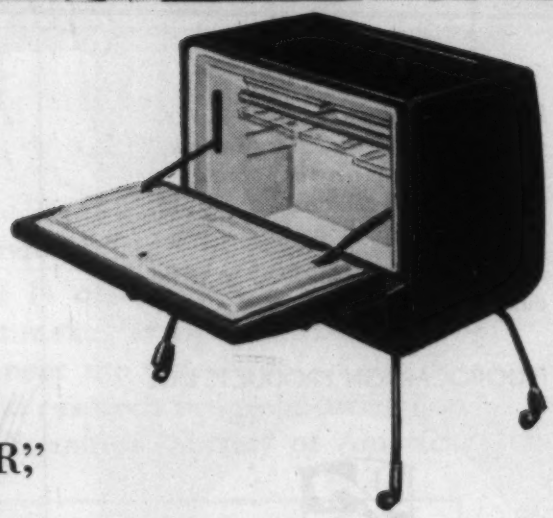
Designed for the automatic detection and inspection of surface flaws in parts on the production line, the mechanical "eye" developed by *Battelle Memorial Institute*, Columbus, Ohio, and the Magnaflux Corp., Chicago, is expected to be particularly useful in the manufacture of automotive, aviation, railway and ordnance equipment where 100% inspection of critical parts is vital to performance and safety.

Known as a photoelectric scanner, the eye is designed for use in two particular types of nondestructive testing where automatic processing and handling equipment are already available—the fluorescent magnetic particle method, and the fluorescent pentrant method.

In both cases, a fluorescent indicating material, applied to the test object, is attracted to the flaw. Scanning is mechanical by a revolving mirror in the optical system. Electronic devices, coordinated with the optical system, can be used to mark the flaw or to have the defective part ejected from the production line.

PLASTICS ADD SALES APPEAL

STYRON gives additional Beauty and Utility to new SERVEL "ELECTRIC WONDERBAR," portable refrigerette



With the handsome new Electric Wonderbar, Servel has created a unique and happy combination of utility and styling. This remarkable portable refrigerette is right at home in the living room, nursery, or as a TV snack spot in the recreation room. It freezes its own ice cubes and is an ideal refreshment center for the family. Doctors and other business executives will find the Servel Electric Wonderbar a useful piece of office equipment, too.

In creating the Electric Wonderbar, Servel used Styron for many of the essential parts. Because Styron (Dow polystyrene) is a durable, odorless, easy-to-clean plastic with excellent insulating properties, it offered a threefold advantage of utility, beauty and sales appeal.

Perhaps plastics can improve your product too; why not work together with experts from Dow's Plastics Technical Service and an experienced molder to give your new product, or present ones, more buy-appeal at the point-of-sale? Write today.

THE DOW CHEMICAL COMPANY
Plastics Department—PL 443C
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SHEETS
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BARS
CYLINDERS
TAPE
MACHINED PARTS
MOLDED PARTS

PROFIT from our broad experience and greater "know-how," and our completely modern specialized facilities for rapid, low-cost production.

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*duPont's trademark for its tetrafluoroethylene resin
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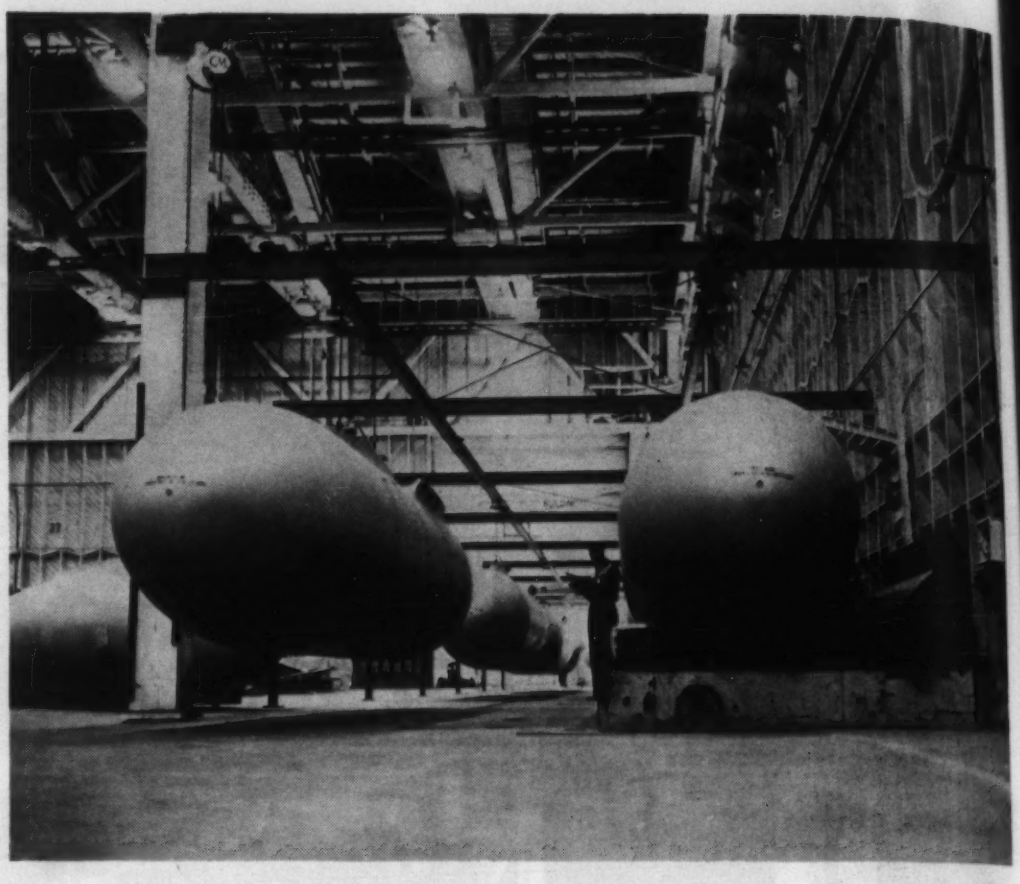


Group of external fuel tanks ready for final inspection (Ryan Aeronautical)

Rubber-Base Coating Resists Abrasion at High Aircraft Speeds

by **BERNARD G. FLOERSCH**
Chief Chemist, Ryan Aeronautical Co.

● THE MAN WHO coaxes the top few miles-per-hr from today's fast combat airplanes may not be an engineer or an aerodynamicist—but a painter. High-speed paint, designed to cover tiny surface variations with a smooth aerodynamic film, is pushing up jet aircraft speeds.

Ryan is adapting this development to the production of the world's largest external fuel tanks for aircraft. These containers are given an exacting surface preparation which reduces their air resistance and adds to their protection against the elements. With this streamlining, plus their design which is patterned after a wing foil section, the big tanks can "keep up" with the speediest planes.

Because the big fuel cells are built with more than 30,000 invisible spot welds, the tank exteriors are quite smooth to start with. But they are not smooth enough to meet the silky slickness required for high-speed flight. At jet aircraft speeds, tiny scratches and bumps become obstacles which upset the smooth laminar flow of the rushing air stream.

The first step in giving the tanks

(Continued on page 186)

PRODUCT DESIGN STUDIES • NO. 43

COST REDUCED 49%
APPEARANCE IMPROVED
DEPENDABILITY ASSURED
WITH STEEL CASTINGS

This is a handle for a mud shaker screen—a device used in oil field drilling to strain chips out of the drilling mud.

These handles formerly were fabricated by blacksmith methods, the handle part proper being made from 1″ round, and the shank from ½″ strip.

Conversion to a *foundry engineered* steel casting reduced the cost of these handles approximately 49%. As shown above, another advantage of the steel casting is improved appearance.

* * *

Here is another example of the engineering teamwork in design and redesign of parts which is resulting in lower costs and improved serviceability with steel castings.

This service is offered without cost or obligation. It makes available through your foundry engineer the full results of the development and research program carried on by the Steel Founders' Society of America.

Keep The Scrap Coming Back . . .

There is a continuing need for steel scrap. Your company can help maintain the high production of all metal products by getting your scrap into the hands of your scrap dealer. Will you do what you can to help . . . now?

STEEL FOUNDERS' SOCIETY OF AMERICA

920 Midland Building — Cleveland 15, Ohio

Design and Build With Steel Castings

you Save... if we can make your TINY PARTS

If you use parts like these (up to ¼" dia. and to 1½" length) in large quantities, it is almost certain that we can show you a big saving. And assure on-time deliveries to meet your pressing defense work schedules. We have something unique back of that claim . . .

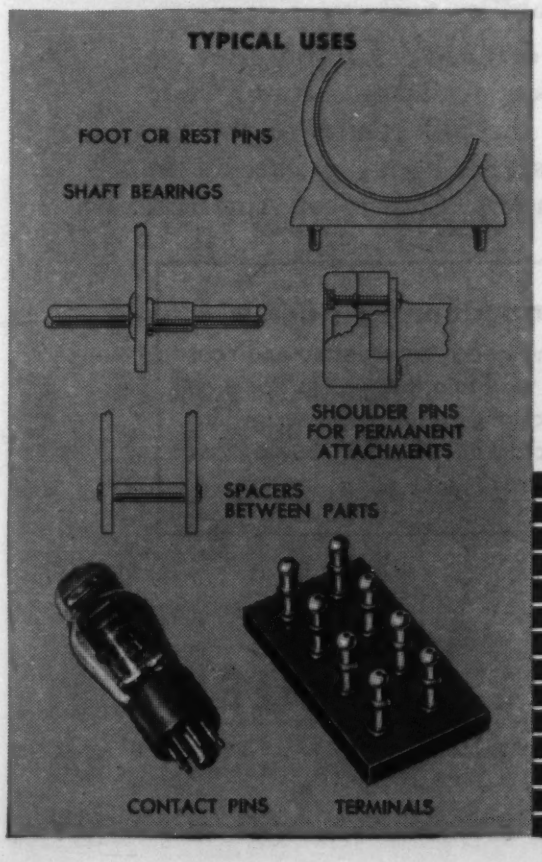
OUR QUOTE IS LOWER BECAUSE NOBODY HAS WHAT WE HAVE To be able to produce our famous Bead Chain to sell for pennies per yard, we had to develop our own equipment and method . . . our MULTI-SWAGE Method.

Instead of turning and drilling small parts from solid rod, or stamping and forming them, this advanced method automatically swages them from flat stock into precision tubular forms, with tight seams. By increasing the production rate many times, and eliminating scrap, this saves a large part of the cost by other methods.

FAMOUS USERS PROVE IT For years leading manufacturers in the radio and electronics field have depended on us to cut costs of millions of contact pins, terminals, jacks and sleeves. And, for pinlike parts and variations of bushings needed for *mechanical* purposes, we are the money-saving supplier to scores of prominent makers of toys, business machines, appliances, ventilators etc.

WHAT WE CAN MAKE Our Bead Chain MULTI-SWAGE Method permits parts to be beaded, grooved, shouldered, and of almost any metal. Generally, they should not exceed ¼" dia. or 1½" length. Catalog shows many *Standard Items* available in small quantity. *Special Designs* must usually be ordered in lots of a half-million or more, unless they are frequently re-ordered.

GET COST COMPARISON! Send blueprint or sample and quantity requirements. Our engineers will return an eye-opener on economy.



Let **BEAD CHAIN** make it by the

MULTI-SWAGE METHOD

I want this Catalog-Data Folder

The Bead Chain Manufacturing Co.
15 Mountain Grove St., Bridgeport, Conn.

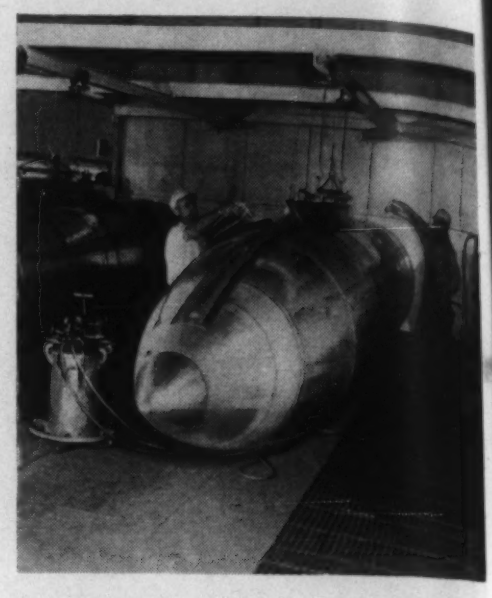
Name, title.....

Company.....

Address.....

Rubber-Base Coating . . .

continued from page 184



Spraying the rubber coating on external fuel tanks for the Boeing B-47B stratojet bomber at Ryan Aeronautical.

a slippery skin begins after final assembly and inspection. They are suspended in a large pressure-ventilated paint spray booth, from overhead monorail conveyors. Attachment is made by means of connectors which fasten to the tank strut fittings. Thinner and alcoholic phosphoric acid solution are used to clean and slightly etch the aluminum alloy surfaces to provide good adherence for the primer, a zinc chromate solution which provides a slightly acid base for the next coat. After a few minutes drying time, a special synthetic rubber-base compound is sprayed on.

Formulated for its aerodynamic advantages, the compound also resists attack by aromatic fuels and is rain erosion-proof at high speeds. This is an important characteristic because, at near-sonic speeds, rain drops can hammer painted surfaces with the destructiveness of small bullets, and have been known to remove ordinary paint as effectively as a desert sand storm.

The preparation must be mixed immediately before its application and cannot be stored, even for a few hours, after mixing. It contains a goodly amount of powdered aluminum which "poisons" the resins in the solvent within a short time after it comes into contact with them. This causes them to jell and become extremely viscous. As the aluminum flakes dissolve, they react with the resins to produce quantities of hydrogen gas which would accumulate excessive pressure in a closed container. A special mixing technique is em-

(Continued on page 188)

Experience + Knowledge = Know-How!

METAL POWDER PARTS
by Moraine

Know-how is the vital commodity in fast, economical, completely satisfactory production of parts from metal powder . . . and Moraine has the know-how that comes from more than a quarter of a century devoted to making billions of Durex metal powder parts.

Our experience, plus the knowledge we direct toward a continuous program of engineering research and production improvements, adds up to the know-how that can be of important service to many industries.

MORAINE PRODUCTS DIVISION OF GENERAL MOTORS DAYTON, OHIO

Vapor FROM Paper STOPS RUST

PACKAGING COSTS CUT FROM $4.95 TO $1.37

Back when messy oil and grease coatings were used to ward off corrosion of diesel locomotive parts, the maker had headaches at both ends of the line.

Packaging steps called for inflammable liquids, heavy handling equipment, air hoses, and varnish-like petroleum solutions. In those days, waxed paper and heavy wooden crates were "musts." At the railroad end, unpacking meant the same troubles in reverse; laborious "cleaning" was a costly chore.

Now, says the diesel firm, "packaging is a dream."

Large and small parts are protected only by a paper that gives off vapor. *It stops rust.* It is Angier VPI* Wrap.

A cylinder liner (see above) is simply put in a container with pieces of the paper. The lid on, VPI goes to work. Now cost of packaging is $1.37 — not $4.95. The liner is ready-to- use when received. No "cleaning" to do.

If you store or ship metal parts or products, get "VPI Facts" from Angier — the most experienced name in vapor rust preventives.

* ® Vapor Rust Preventive

Distributors in All Principal Cities

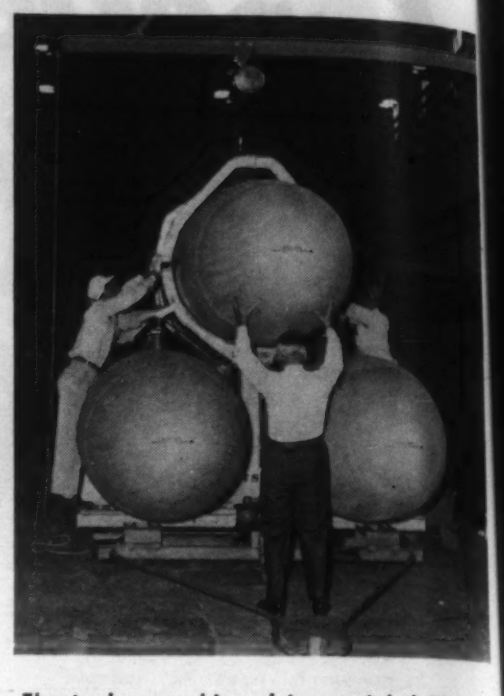
Angier Corporation, Framingham 14, Mass.
Send "VPI Facts" as applied to:

- ☐ Machinery-Industrial, Metal Working, Farm, Office, Construction.
- ☐ Electrical Machinery, Appliances, Products.
- ☐ Transportion Equipment — Auto, Aircraft, Naval, Railroad, etc.
- ☐ Fabricated Products — Cutlery, Hardware, etc.
- ☐ Steel in process of fabrication.
- ☐ Ordnance Equipment.
- ☐ Instruments and clocks.
- ☐ Other.

Sign below; attach to your letterhead

Rubber-Base Coating . . .

continued from page 186



The tanks are shipped in special dollies to prevent damage in shipment. (Ryan Aeronautical)

ployed to insure that the tiny aluminum flakes spread out in the resins and lie as flat as possible on the fuel tank surfaces.

After spraying, the tanks are rolled out of the spray booth, on the monorail conveyors, into the final assembly building. They are wet-sanded and hand-rubbed until the finish is perfectly smooth. Instructions and fitting locations are stenciled on with vinyl lacquer, the only coating which seems to adhere to the compound.

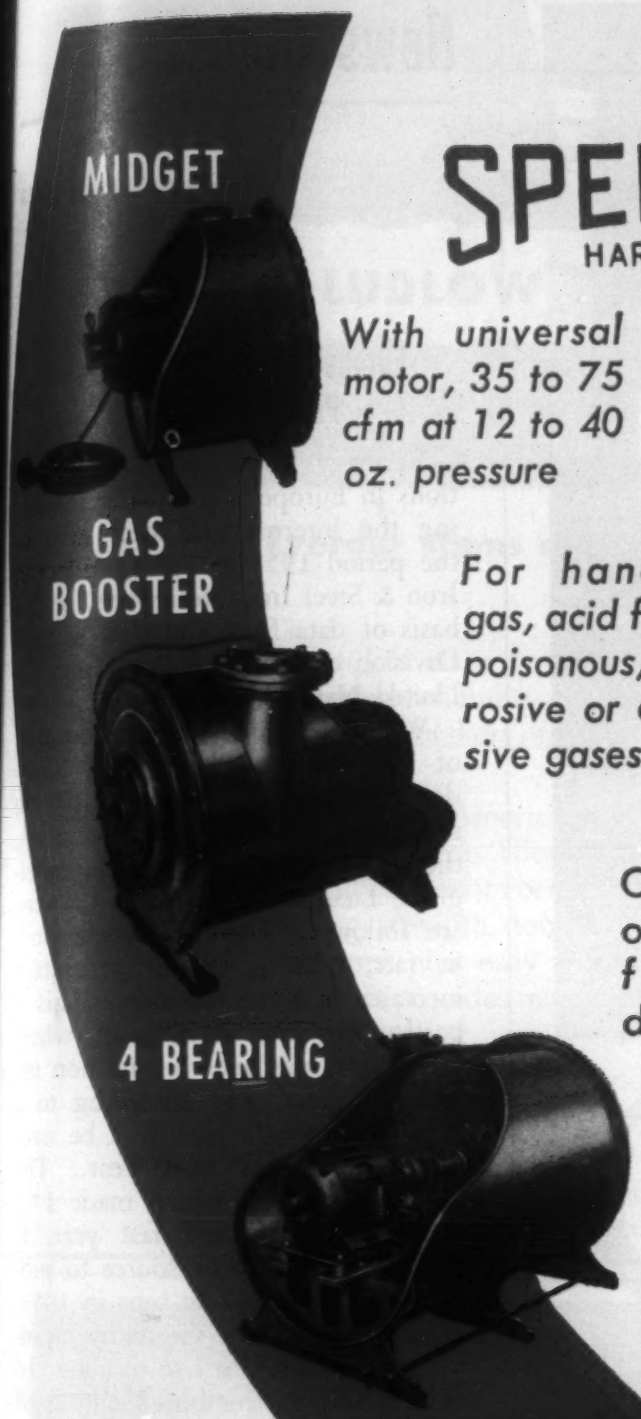
At the end of the conveyor lines, a crane, fitted with a dial-type weighing gage, hoists each tank from the monorail. The exact weight is noted, en route, and the tank is placed in an inspection dolly. Here it is given a minute, final inspection by Ryan and Air Force inspectors.

Manuals Still Available!

Reprints of the majority of the "Materials & Methods Manuals" are still available. See page 236 for a complete list of these Manuals.

SPENCER HARTFORD

SPENCER TURBOS FOR SPECIAL OCCASIONS



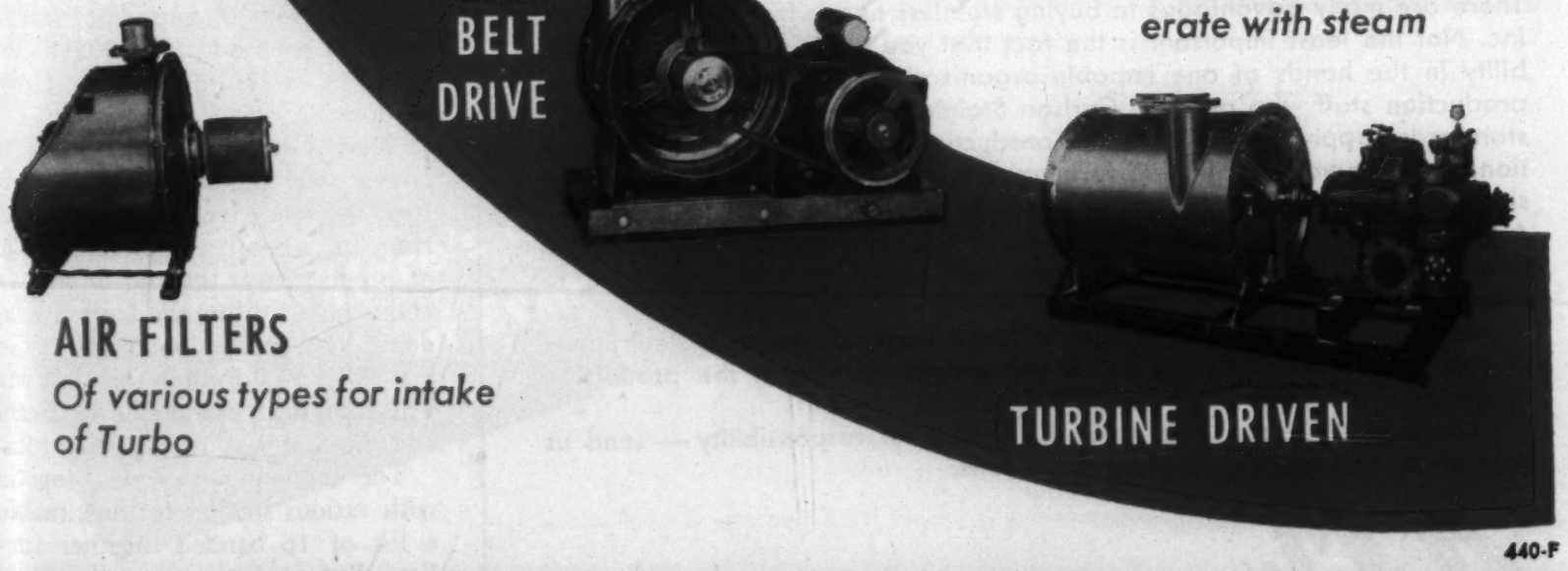
With universal motor, 35 to 75 cfm at 12 to 40 oz. pressure

For handling gas, acid fumes, poisonous, corrosive or explosive gases

Overhang or outboard type for coupled drive

For odd frequency or other than electric motor driven

For use where it is desired to operate with steam



AIR FILTERS
Of various types for intake of Turbo

Standard motor driven Spencer Turbos are listed in more than 160 sizes. For special applications, there are many variations, six of which are illustrated.

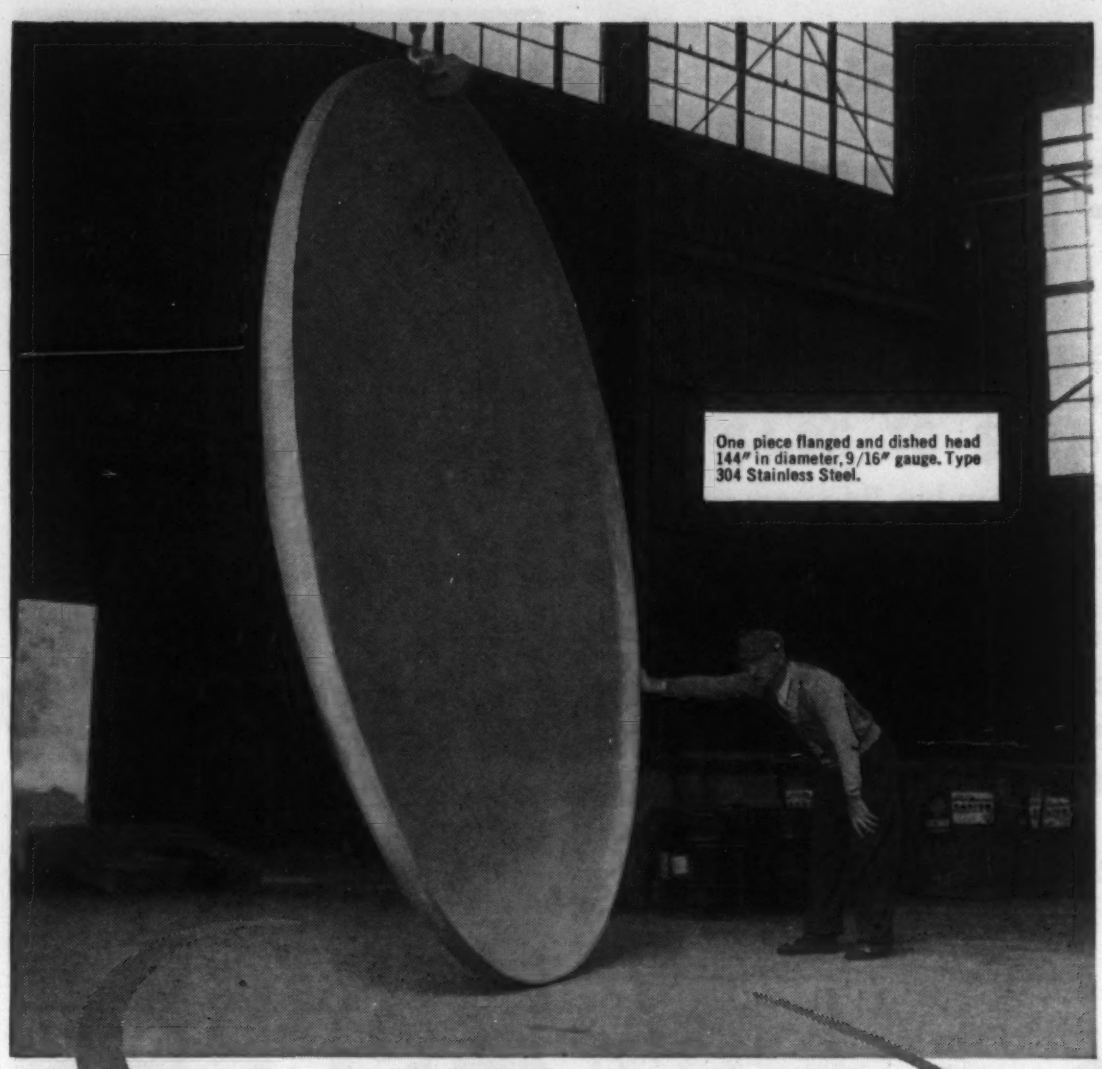
Spencer Turbos range in size from 35 to 20,000 cu. ft. per min. 4 oz. to 10 lbs. and 1/3 to 1,000 h.p.

For complete description of the standard and special Turbos ask for Bulletin No. 126-A.

440-F

THE SPENCER TURBINE COMPANY • HARTFORD 6, CONNECTICUT

SPENCER HARTFORD



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News Digest

continued from page 13

Europe's Steel Map Shifts in Postwar Recovery

Recovery from the war's dislocations in Europe is gradually redrawing the international steel map in the period 1951 to 1953, American Iron & Steel Institute reports, on the basis of data from the Iron & Steel Division of the NPA, and from the United Nations.

While the three leading countries of Free Europe—the United Kingdom, France and Germany — are striving to better their steel position, the smaller countries, including Belgium, Luxembourg, Saar and others, are following a similar course, and, in fact, making greater percentage increases in some instances. This is particularly true of Belgium, where production was over 5.5 million net tons last year, and according to a United Nations report will be over six million tons next year. The United Kingdom, which made 17.5 million tons of steel last year, is expected by the same source to produce nearly 20 million tons in 1953. Production in West Germany meanwhile is expected to rise to about 16 million and the combined output of France and the Saar to over 16 million net tons. Luxembourg, which made 3,393,000 tons last year, is expected to produce 3,500,000 tons in 1953, according to the United Nations.

West Germany, which was the largest steel producer in Europe before the war, is recovering rapidly from an almost complete cessation of production at the end of the war, and is now rivaling the United Kingdom. The production of West Germany was 14.9 million tons last year. The combined production of France and the Saar was 13.7 million tons.

The foregoing countries, together with various smaller nations, making a list of 16 banded together for a Free Europe, are expected, according to a United Nations study, to produce 72 million net tons of steel next year. Seventy-two million tons is approximately their capacity at the beginning of this year, according to a recent study made in the United States. It is indicated that Russia and her satellites would produce about

NO LUDLOW FIRE HYDRANT HAS EVER FAILED IN LINE OF DUTY!

Everdur stems resist stresses, strains and corrosive attack

Everdur* has helped to endow many types of products with the same time-tested reliability of performance of which the makers of these Ludlow Fire Hydrants are so justifiably proud.

Everdur,* The American Brass Company's group of Copper-Silicon Alloys, has long demonstrated its ability to resist corrosion while at the same time providing strength, toughness and unusual fatigue resistance plus easy workability and weldability. It provides many of the properties required for tin-bronze application.

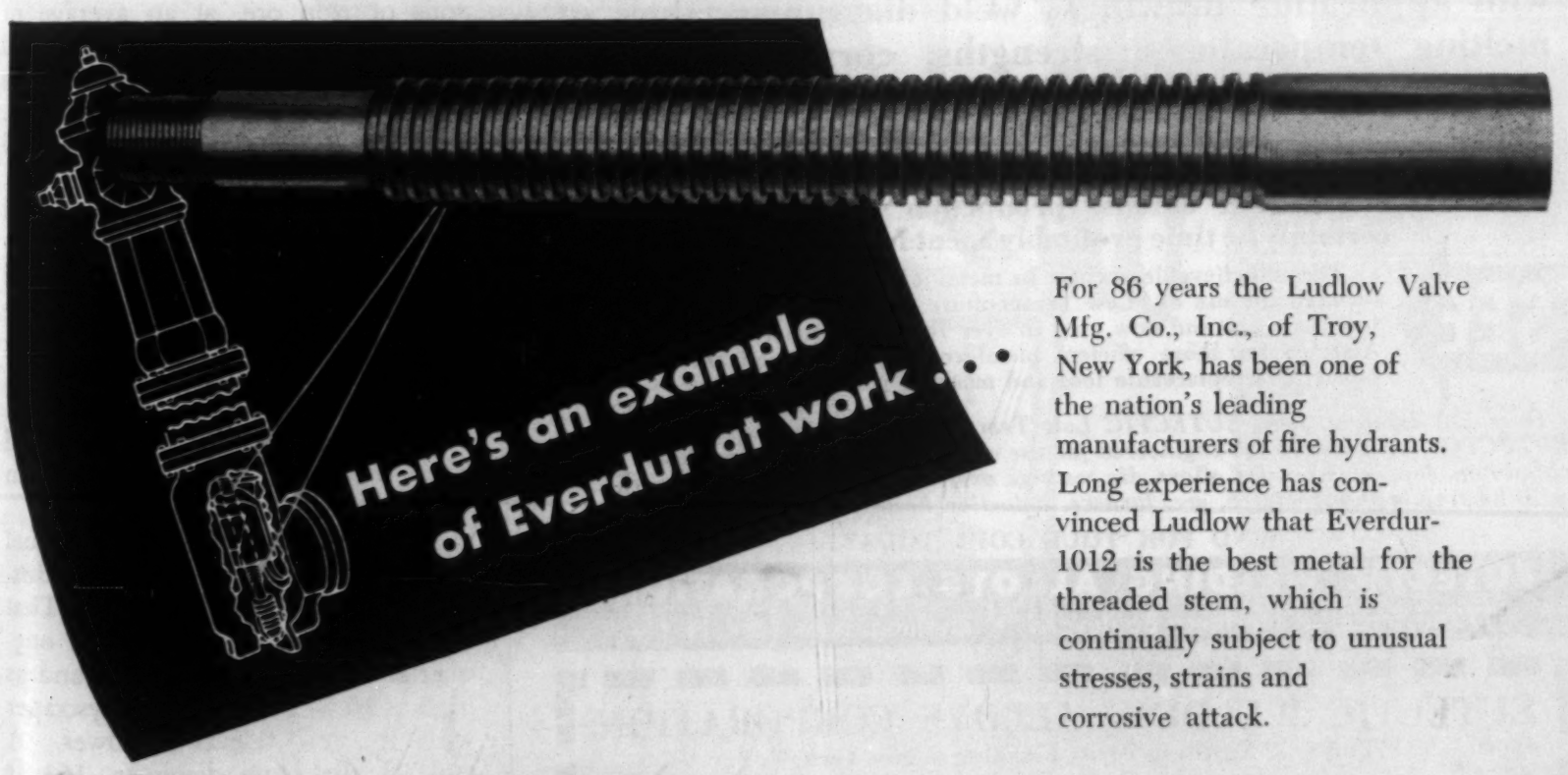
Tell us what you make – and how it is to be used. We'll do our best to help you get the right metal. It may be Everdur or one of a dozen different ANACONDA Alloys. Address The American Brass Company, General Offices, Waterbury 20, Connecticut.

*Reg. U. S. Pat. Off. 5289

EVERDUR is produced in nearly all commercial forms including casting ingots for remelting. It offers:

High Strength and Toughness
Unusual Fatigue Resistance
Excellent Corrosion Resistance
Weldability plus *Workability*
Machinability

Publication E-5 gives Applications, Physical Properties and Constants of Everdur. Publication E-1, on Everdur Casting Ingots, describes Foundry Practice and Procedure. Write for either or both.



The Everdur-1012 (free-cutting alloy) stem, used in the Ludlow Hydrant, is 15" long with a 1-5/16" –4 square–cut thread.

For 86 years the Ludlow Valve Mfg. Co., Inc., of Troy, New York, has been one of the nation's leading manufacturers of fire hydrants. Long experience has convinced Ludlow that Everdur-1012 is the best metal for the threaded stem, which is continually subject to unusual stresses, strains and corrosive attack.

EVERDUR

ANACONDA®

COPPER-SILICON ALLOYS

STRONG • WELDABLE • WORKABLE • CORROSION-RESISTANT

this new **WELDING DESIGN MANUAL**

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FOR THE ASKING

72 PAGES
PROFUSELY ILLUSTRATED

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WELDING ALLOYS

To assist you in your re-tooling problems . . . or to help you analyze your present welding methods so that you may enjoy maximum speed, efficiency, and economy in many of YOUR production problems . . .

Giant new 4th Edition contains 62 new photographs, 132 new drawings, 72 pages of helpful data covering basic and advanced welding techniques and designs used in fabricating and assembly. Profusely illustrated with application drawings; weld diagrams; tables of melting temperatures, strengths, corrosion factors; charts; alloy recommendations; etc. Convenient digest size.

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SEE . . . **The unbelievable savings in metal-joining which can now be yours through the use of "Low Temperature Welding Alloys"® discovered a few years ago and now used in over 78,000 industrial plants throughout America for more efficient metal-working production as well as for salvaging irreplaceable tool and machine parts.**

Over 100 different, new, EUTECTIC Low Temperature WELDING ALLOYS® and EUTECTOR® Fluxes are job-engineered for use on ALL metals – cast iron, alloy steels, aluminum, copper and nickel alloys, die castings, overlays, etc., and may be applied with ALL heating methods – torch, arc, furnace, induction heating, etc.

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News Digest

55 million net tons of steel next year, giving Free Europe a margin of nearly 17 million tons of production over the output behind the iron curtain.

More Raw Materials Used in 1951 Than Ever Before by Steel Plants

On the average, the furnaces of the iron and steel industry used iron ore at the rate of a pile with the dimensions of the Empire State Building every 11 days last year, according to the American Iron & Steel Institute. More iron ore and other raw materials than ever before had to be assembled by steel companies during 1951 to produce the greatest amount of steel ever made in a year —105 million tons of ingots and steel for castings.

Iron and steelmaking furnaces consumed nearly 130 million net tons of iron ore, at an average of 247 tons every minute. That total was larger by more than 10 million tons than the amount used in 1950.

About 100,200,000 tons of coal was used by the industry in 1951, exceeding the previous year's record by 8.3%. If loaded in 50-ton hopper cars, that amount of coal would fill a train long enough to go more than half way around the world at the equator.

The consumption of coke in 1951 was 68 million tons, a record, and over five million tons more than in the previous year.

More than 2.5 billion gal of fuel oil was consumed by the steel industry, 10% more than in 1950. That amount of oil would fill a tank one-quarter of a mile in diameter and as high as New York's tallest skyscraper with its new television tower. A tank of the same diameter, 163 ft high, would be needed for the 284 million gal of tar and pitch used.

Revised figures on the consumption of natural gas show a record of nearly 207 billion cu ft burned in the industry, an increase of about 1.4% over 1950 use.

Enough electric power was used

DO YOU HAVE *tough* X-RAY INSPECTION JOBS?

At the American Steel Foundries' plant in Newark, New Jersey, heavy steel castings are easily X-rayed due to equipment *flexibility.*

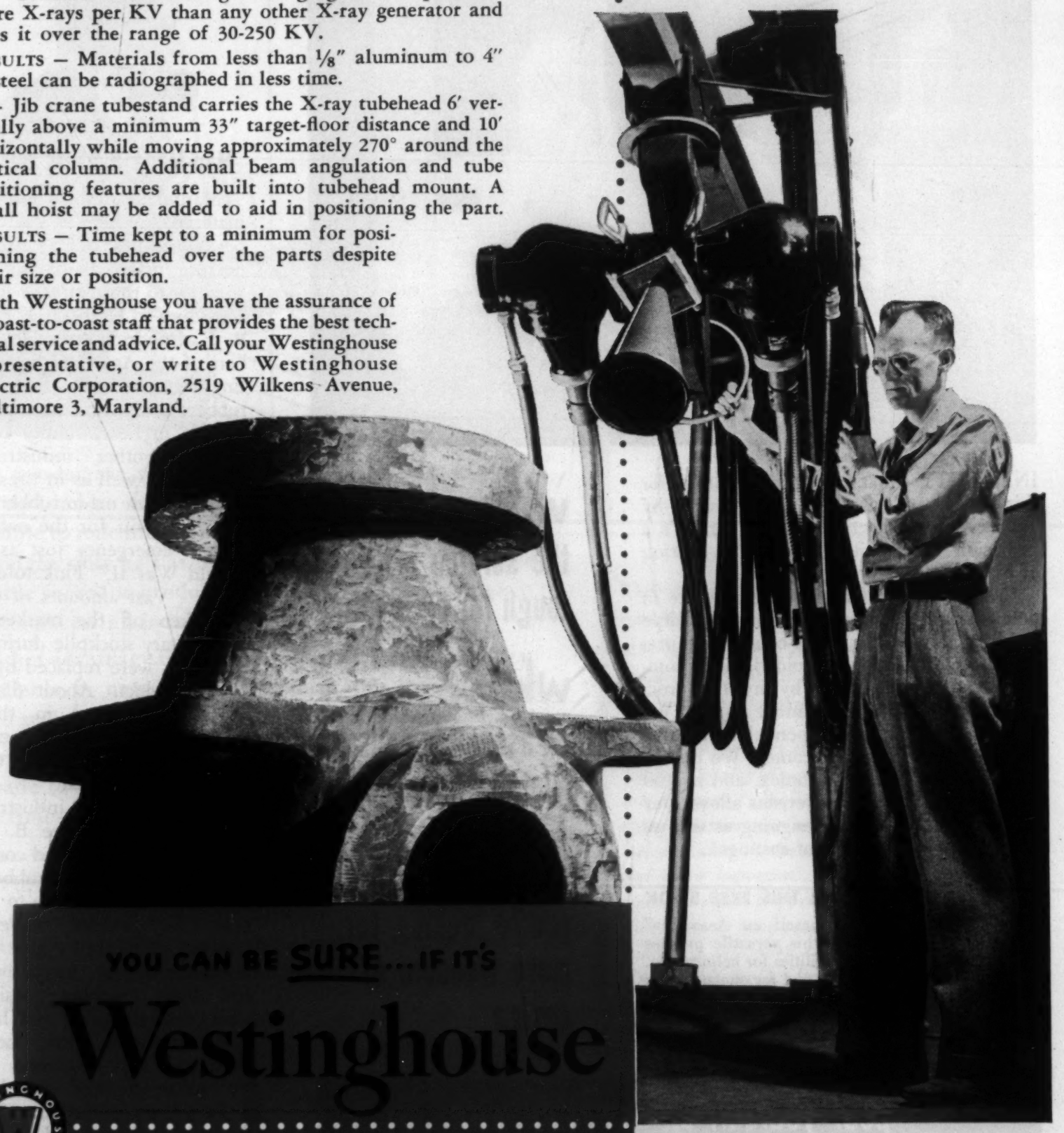
1 – *Constant Potential* high voltage generator produces more X-rays per KV than any other X-ray generator and does it over the range of 30-250 KV.

RESULTS – Materials from less than 1/8" aluminum to 4" of steel can be radiographed in less time.

2 – Jib crane tubestand carries the X-ray tubehead 6' vertically above a minimum 33" target-floor distance and 10' horizontally while moving approximately 270° around the vertical column. Additional beam angulation and tube positioning features are built into tubehead mount. A small hoist may be added to aid in positioning the part.

RESULTS – Time kept to a minimum for positioning the tubehead over the parts despite their size or position.

With Westinghouse you have the assurance of a coast-to-coast staff that provides the best technical service and advice. Call your Westinghouse representative, or write to Westinghouse Electric Corporation, 2519 Wilkens Avenue, Baltimore 3, Maryland.



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INDUSTRIAL X-RAY

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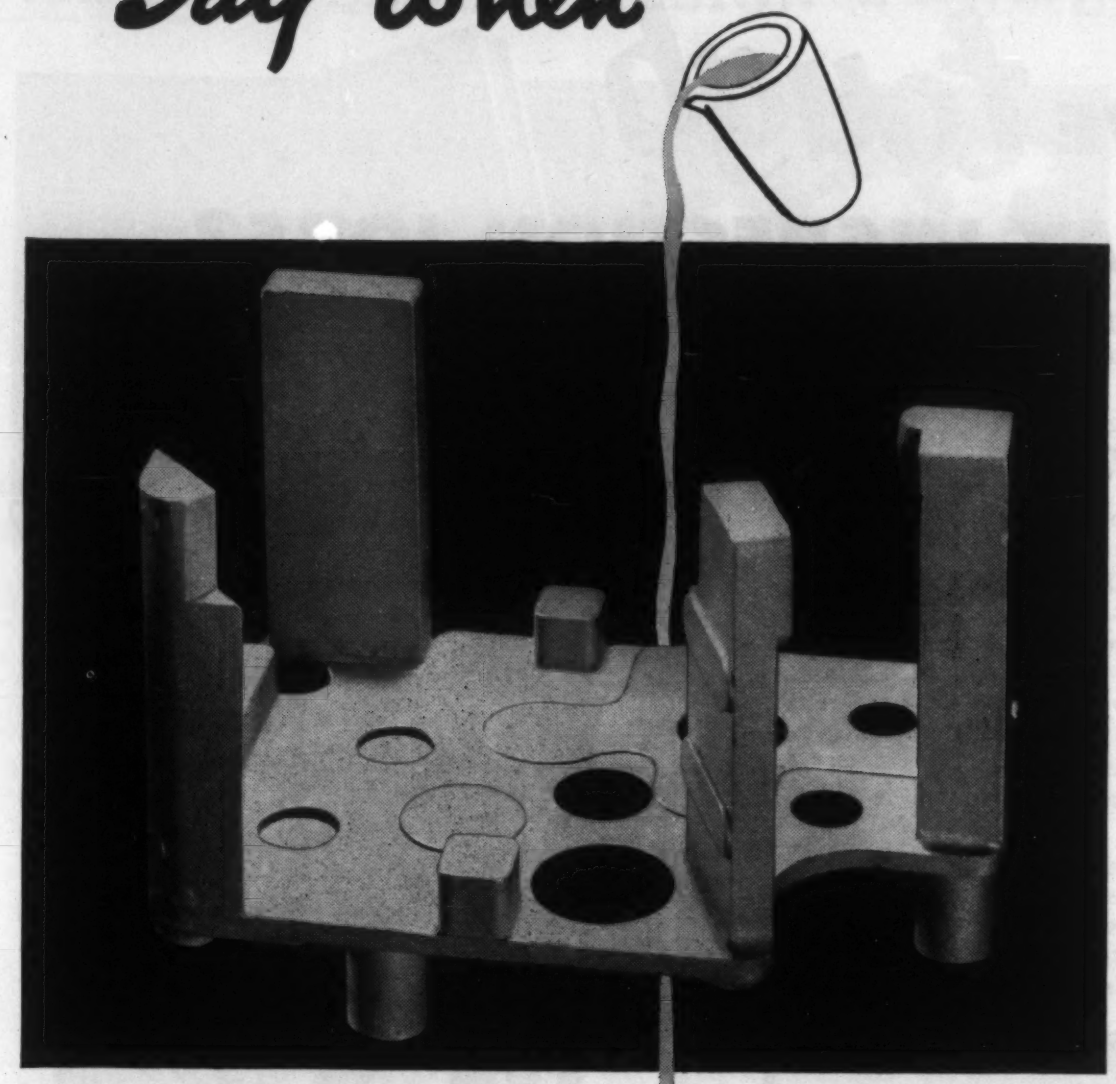
Say "when"



INTEGRITY—that's the prime requisite for this instrument base; a property proved by 100% X-ray inspection of this part. It's a Precision Metalsmiths' *Investment Casting* of 316 stainless steel.

Cast to close tolerances and accurate in details, such parts require surprisingly little finishing. Expensive, time-consuming pre-assembly machining is avoided, since complicated parts not possible by any other process are produced as investment castings. We do the assembling with expendable patterns.

Your inquiries are welcomed. We cast in any shape, simple or complex, and in 160 different ferrous and nonferrous alloys. Our engineers will assist in designing as well as producing your investment castings.

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the service is too tough for die casting

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an assembly calls for a lot of pre-machining

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you're looking for more freedom of design

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INVESTMENT CASTINGS

News Digest

by iron and steel plants during the year to supply 13.8 million urban and non-farm residential customers. About 27,611 million kw hr was used by the industry, a record high and nearly 12% more than in 1950.

Man-Made Rubbers Here to Stay

Man-made rubbers and rubber-like materials are here to stay, not as rubber substitutes, but as essential engineering materials having properties superior to those already in existence, according to Herbert H. Fink of The B. F. Goodrich Co. He told members of the American Society of Tool Engineers recently that man-made rubbers are setting new performance records in hose, rubber belting and countless other industrial rubber products as well as in tires.

"American made rubber has saved the day again for the nation in the current emergency just as it did in World War II," Fink told the engineers. "Vast amounts of crude rubber taken off the market to build the military stockpile during the past two years were replaced by the man-made product. About 65% of the new rubber used in the United States last year was man-made, with the industry producing at the rate of 850,000 tons a year."

Discussing the industrial application of rubber, the B. F. Goodrich executive described commercially available man-made rubbers which have superior resistance to petroleum base oils, gasoline, solvents; have low gas permeability and very great resistance to tear, ozone, weathering and light cracking; resistance to acids, sunlight-aging and heat-aging.

According to Fink, men in the laboratory and engineers in industry can be credited with helping to make rubber go farther today, pound for pound, than it did ten years ago. Rubber products still take as much rubber as they used to, but practically all rubber products wear longer than they did in 1942, Fink said.

"Automobile tires give up to 25% more wear. Some rubber conveyor

Production Men like

TAYLOR VULCANIZED FIBRE

because...

Here's a production man's dream—a uniform easy-to-work material that can be readily machined in any manner in which it is possible to machine metal. Yes, Taylor Vulcanized Fibre, which weighs only half as much as aluminum, is a real time and trouble saver for production men in nearly every branch of the manufacturing industry.

And another advantage in using this workable material is that it is available in numerous forms including sheets, strips, rods, and rolls, and in a wide range of sizes and thicknesses.

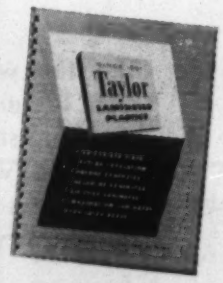
When production schedules call for the purchase of *fabricated* parts, made to your specifications, Taylor can furnish them, too—on time—ready for your assembly lines.

It will be well worth your while to get all the facts about Taylor Vulcanized Fibre. You may find new ways and means to use it in making your products better, faster, and cheaper. Let us also give you the details about other Taylor products, such as Phenol, Silicone, and Melamine Laminates, as well as Taylor Insulation.

In the railroad field...

Rail-joint insulation—which must withstand, year-after-year, the brutal pounding of locomotive and car wheels—offers conclusive proof of the inherent "toughness" of Taylor Vulcanized Fibre.

This 62-page fact-filled Taylor Catalog describes how the many Taylor Laminated Plastics are made, how and when they're used, and more important, how you can use these basic materials to make your product better... at lower cost! Write today for a copy of Catalog MM 11.



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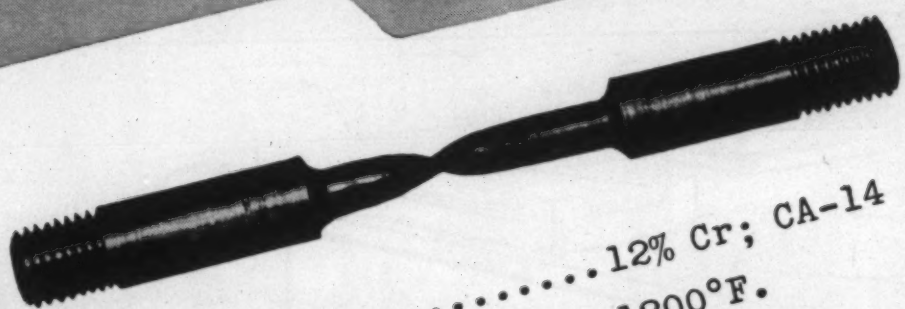

Test Rod.....12% Cr; CA-14
Test Temperature.....1200°F.
Tensile Strength.....38,200 psi.
Elongation (2").....29.5%
Reduction in Area.....86.1%

That's high quality metal! Metal destined for a high alloy casting which has to meet some pretty rigid specifications!

The story we want to tell here is about our Testing Facilities. We have right in our foundry every conceivable testing facility needed when checking static or centrifugal high alloy castings for industry. Where required, we make complete chemical, metallurgical, and mechanical checks and tests. And have both a 400,000 volt X-ray unit and gamma-ray unit, for checking the final casting for hidden flaws.

As we see it, the only way to assure customers of high quality castings is to have and use all necessary facilities for testing and checking the heat, pour and finished casting.

THE DURALOY COMPANY

Office and Plant: Scottdale, Pa. · *Eastern Office:* 12 East 41st Street, New York 17, N.Y.

Detroit Office: 23906 Woodward Avenue · Pleasant Ridge, Mich.

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News Digest

belts outclass their 1942 counterpart by 60% on tonnage carried. Use of man-made rubber in industrial hose tubes and covers has helped increase hose life in some cases by 500% in the past decade," he said.

New Rubber Laboratory Opened

One of the newest laboratories at Armour Research Foundation offering confidential research to private industry is the rubber laboratory. It is designed to include all the facilities of a commercial rubber plant.

The laboratory is headed by Dr. A. G. Susie, supervisor of the Plastics and Rubber section of Chemistry and Chemical Engineering. Other staff members are F. W. Bickel, research rubber chemist; Paul Stoeck, technician; Alieta Murer, technician; and J. Albreght, technician.

Starting with natural or synthetic rubbber plus various other ingredients, these people turn out rubber of various kinds and in various forms for experimental purposes.

The laboratory's facilities are available for all types of rubber work. Among these are the compounding of natural and synthetic rubbers to obtain specific properties and use requirements, the evaluation of rubber compounding ingredients, and the evaluation of new synthetic rubbers.

Metal Finishers' Association Surveys Plating Industry

The National Association of Metal Finishers, Inc., is now running a survey of the plating industry in the United States. When it is complete, this survey will show how the size, equipment, production methods and products of electroplaters vary. The survey will also serve as a guide to

Typical pipes and fittings of nonplasticized polyvinyl chlorides fabricated to specifications by Van Dorn.

Van Dorn

INDUSTRIAL PLASTICS OFFER YOU—

√ High Resistance to Acids & Alkalies

√ Tensile Strength of Aluminum, with one-half its weight

√ Readily Formed, Machined, Drawn Molded or Welded

AVAILABLE FORMS

SHEETS . . . . $\frac{1}{32}$" through 1"

PIPE . . . . . $\frac{1}{2}$" through 4" diameter (10 ft. lengths)

ROUND BARS . $\frac{1}{4}$" through 2" diameter (10 ft. lengths)

WELDING ROD . $\frac{1}{8}$" and $\frac{3}{16}$" diameter

TYPICAL APPLICATIONS

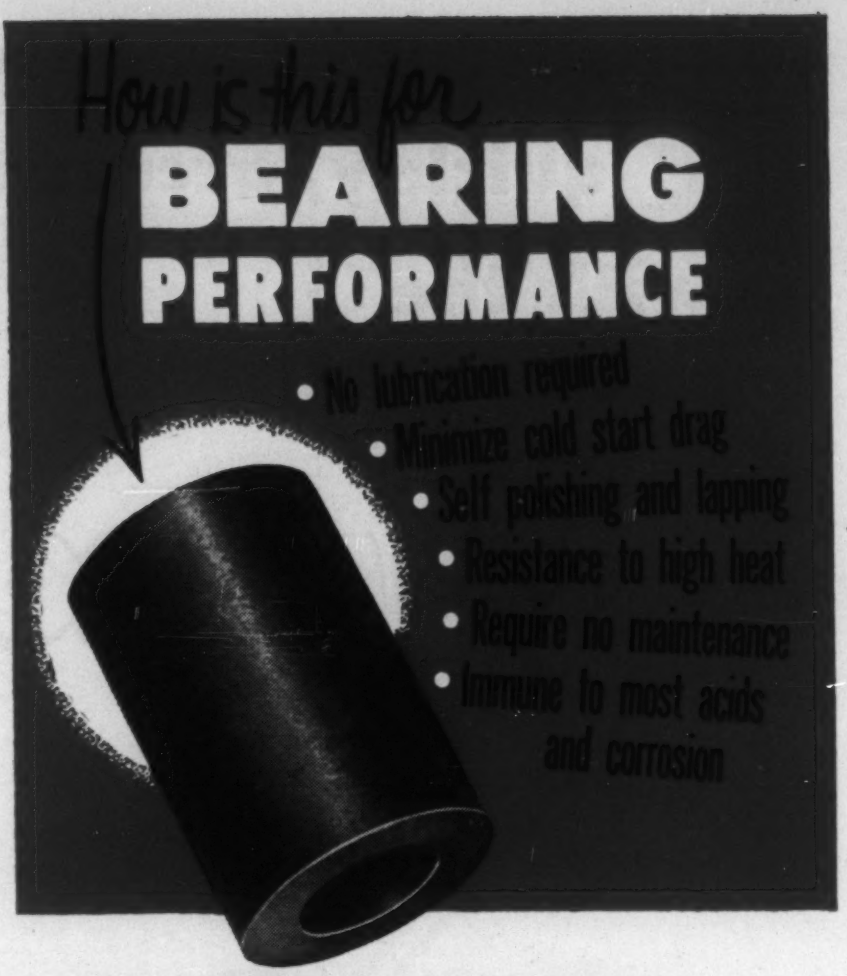
Van Dorn fabricates its rigid nonplasticized polyvinyl chlorides into such products as: Ducts, Hoods, Chemical Tanks, Tank Liners, Plating Racks, Fume Stacks and Piping.

WRITE FOR ILLUSTRATED BULLETIN AND SPECIFICATIONS

INDUSTRIAL PLASTICS DIVISION

THE VAN DORN IRON WORKS CO.

2699 East 79th Street • Cleveland 4, Ohio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• No lubrication required
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Cut maintenance costs...
Reduce shutdown time...
Increase production...

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SELF-LUBRICATING
CARBON BEARINGS

APPLICATION: Extensive—from food machinery and guided missiles, to household appliances and steel mill equipment.

DESIGN: Manufactured to specification to exactly meet your requirements. For inaccessible locations, sealed mechanisms and unusual operating conditions.

CHARACTERISTICS: Self-lubricating action is derived from the inherent nature of the material. Thus will not warp, contaminate or impart taste or odor. Unaffected by high temperatures.

ECONOMY: Morganite is self-polishing and self-lapping, eliminating costly finishing.

Call or write for recommendations on specific problems, or request illustrated literature. See our bulletin insert published in Sweets Product Design File for further details.

see our CATALOG in SWEET'S FILE

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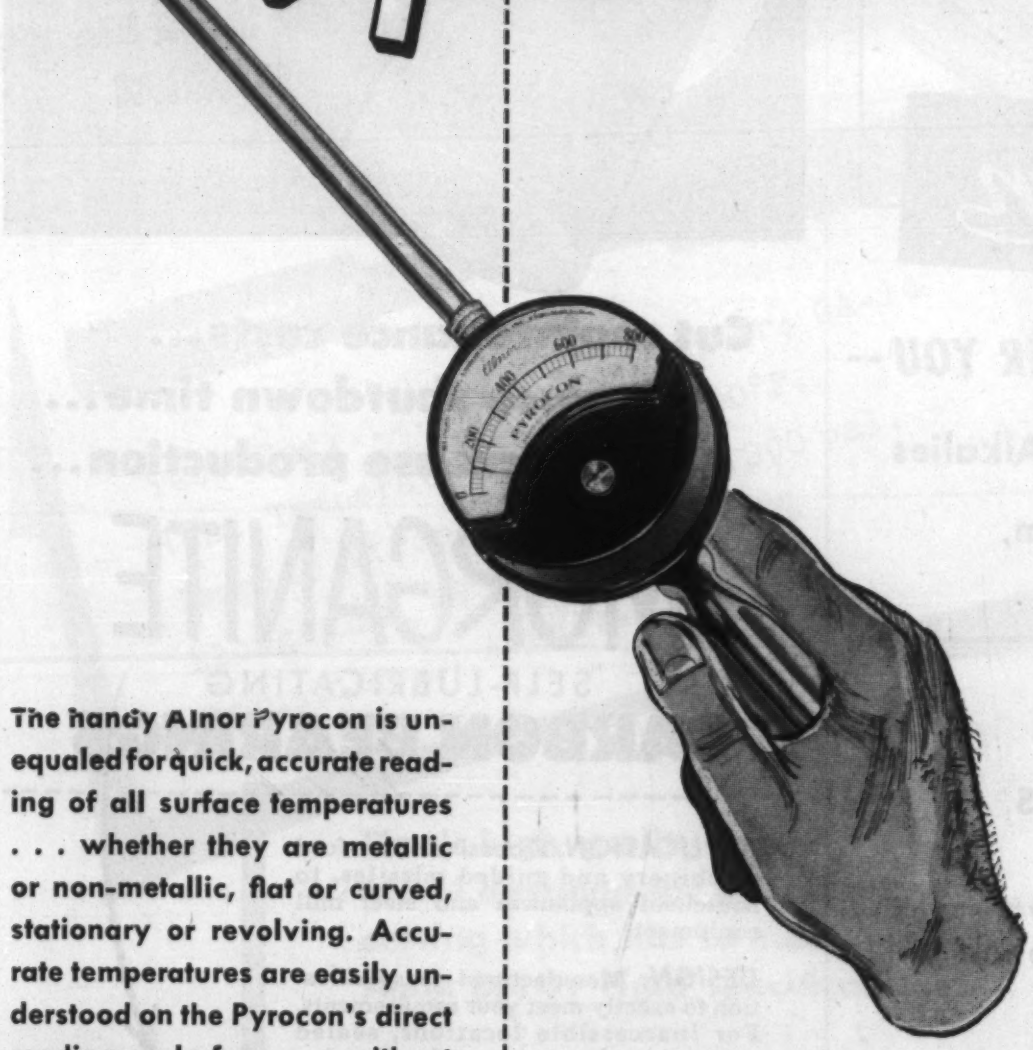
Take surface temperatures quickly, accurately... with the

Pyrocon



The handy Alnor Pyrocon is unequaled for quick, accurate reading of all surface temperatures . . . whether they are metallic or non-metallic, flat or curved, stationary or revolving. Accurate temperatures are easily understood on the Pyrocon's direct reading scale face . . . without interpolation or need of conversion tables. A wide selection of thermocouples and extension arms permits adaptation to many types of service. For complete details and prices, send for Bulletin No. 4257. Illinois Testing Laboratories Inc., Room 522, 420 N. LaSalle Street, Chicago 10, Ill.

Alnor

PRECISION INSTRUMENTS FOR EVERY INDUSTRY

News Digest

the capacity available for defense contracts.

The questionnaires have been sent to 3526 companies engaged in plating. With 9.2% returned, the figures presented convinced the NPA of the desirability of relaxing the stringent regulations pertaining to the use of nickel by platers. A nickel strike is now permitted on all items within the extent of the allowable allocations.

While the results so far have been good, the Association is striving for a 90% return of questionnaires.

Ductile Iron Now Commercial, Inco Says

At a recent press conference, The International Nickel Co., Inc., announced that Ductile Iron had reached the stage where it can be considered as a fully commercialized product.

Introduced to the foundry industry by Inco in 1949, Ductile Iron reached an output of 50,000 melt tons in 1951 and will reach 80,000 to 100,000 melt tons in 1952. Commercial castings range from those weighing a few ounces, with sections as thin as 1/10 in., to those weighing as much as 50 tons, while more than 200 foundries are producing the material.

Ductile Iron, which has also been called spheroidal graphite iron and nodular iron, bridges the gap between gray cast iron and cast steel. It is sufficiently ductile to be bent, twisted or otherwise deformed, and is stronger than gray iron. The elongation of as-cast material ranges from 3 to 15%; that of annealed material is as high as 20%. Although usually used in the as-cast or annealed condition, the mechanical properties of Ductile Iron can be improved by heat treatment.

The excellent fluidity of Ductile Iron permits the production of intricate castings, which are difficult to produce in competing materials, while the properties of the castings

Remington Rand Methods News

The case of the punch press that was not popular

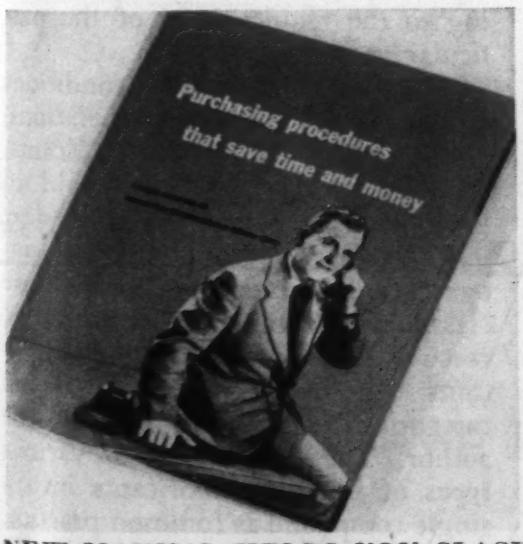
When a well-known manufacturer switched to Remington Rand punched-card costing, the new detailed reports revealed surprising doings in the shop.

For instance, one report indicated a certain type of punch press was the most efficient on a particular operation. But another report showed the press was not being used on this operation. Investigation revealed that workers preferred a different type of press which was easier to operate. Management now had all the facts needed for effective action.

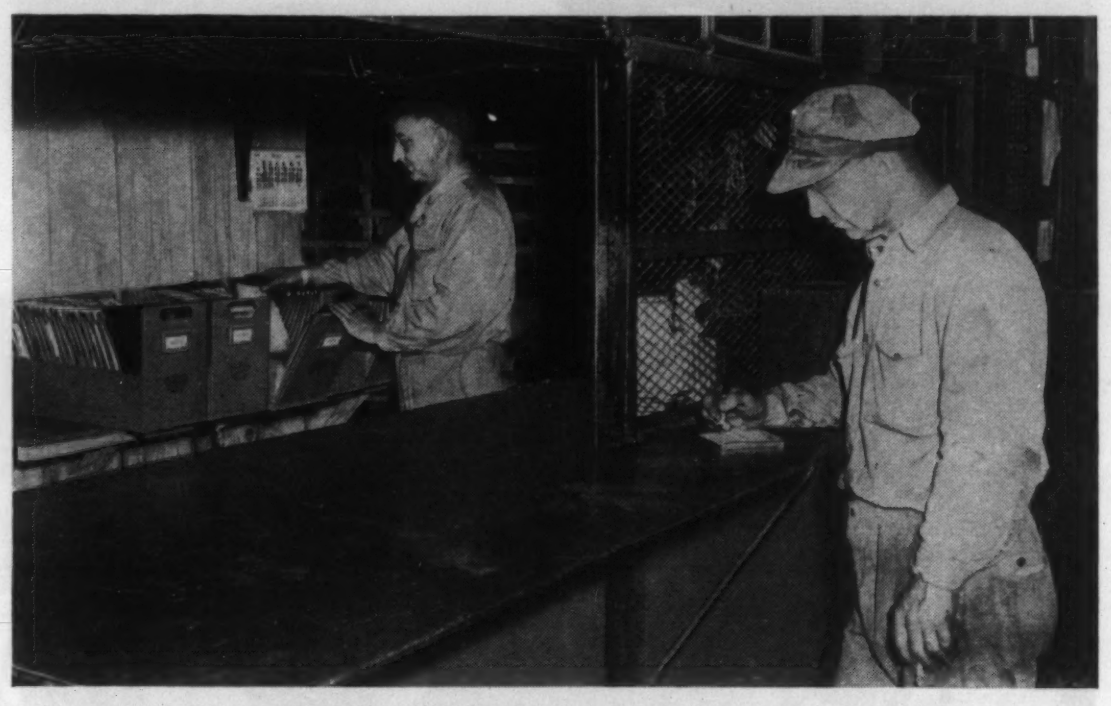
What's more, this new system put the finger on profit leaks much faster. Instead of waiting 30 days to get sketchy facts, management now gets complete cost reports 5 days after completion of a job.

Naturally, costing is just part of the punched-card accounting operation which helps the firm produce better products at lower cost with better service to customers. Let us show you how it also simplifies materials management, production control and payrolls. Ask for case history folder **SN-752.**

If you'd be interested in punched-card services to get the same informative records without setting up your own punched-card department: folder **BSD-6.**



NEW MANUAL HELPS YOU SLASH PURCHASING PAPERWORK COSTS— Here are 20 pages of practical ideas to save time in the purchasing department; to give buyers complete information for sound purchasing decisions. Case histories show you how others profit by using the illustrated forms, methods and procedures. Covers every phase of paperwork from receipt of requisition to closing of order file. Ask for manual X-1202.



TOOL CRIB UNDER CONTROL. Say goodbye to your old-fashioned tool check-out methods. This simple *visible* method will double-check itself to prevent errors in charging out tools . . . enable each tool center to keep its own records accurately, easily . . . give you tool inventory control as a by-product. Get details from folder KD-641.

How a plant doubled its turnover rate on parts and materials

Within six months after putting in a new materials control program, this plant reduced its parts inventory by a million dollars—and doubled its turnover rate—yet maintained a better cushion against shortages than before.

Because delivery schedules for incoming materials were tied in closely with production schedules, the plant also eliminated unnecessary handling of material and warehousing.

Heart of this system was a Kardex materials control record giving fast *visual* analysis of status of each individual item. Without referring to ledger entries, the clerk could spot any item which threatened to slow production.

Yet, for detailed analysis, this type of record also furnishes a complete and convenient history of each item, including purchases, usage and projected requirements for coming months.

Whether you have 500 or 50,000 parts, you will find this flexible method is invaluable for maintaining the proper balance between the cost of acquiring an item and the cost of possessing it. If you have punched-card production records, this method provides a positive supplement to your control system. For details, see our methods file **MC-767,** available on loan for your study.

QUICK RELIEF FOR COMMON HEADACHE IN PRODUCTION

A small part can cause a big headache—when it's the wrong part. Poor description of parts causes all kinds of trouble: production delays, duplicate stocks and high paperwork costs. But the cure is simple. Identify and classify each item properly, so it can be referred to by exact number. The cost is less than you may think. Our engineers have built up a special library of standard nomenclature and numbering systems which can be readily adapted to your parts and materials. For more details, see our booklet **BSD-10.**

Remington Rand

Management Controls Reference Library
Room 1487, 315 Fourth Ave., New York 10

Please circle the literature you desire:

SN-752	**BSD-6**	**X-1202**
KD-641	**MC-767**	**BSD-10**

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News Digest

overlap those of gray iron, malleable iron and cast steel.

Applications include gears, pipe and fittings, pressure castings, crankshafts and various machine parts.

Lubricants for Drawing Metals

Lubricants for drawing metals were discussed in a technical paper presented at the annual convention of the Association of Iron & Steel Engineers by Allen A. Brown, Reilly-Whiteman-Walton Co.

Following a review of fundamental considerations in the severe cold working of metals, the prevention of welding of portions of work piece surface to forming tools was discussed as a most important function of a drawing lubricant. This ability to prevent welding must be obtained from a lubricant which will also provide a low frictional coefficient. Maximum reduction of surface friction is not always desirable, however.

These primary drawing lubricant functions were redefined in terms of separation and slip. The separating and slip producing phases may be applied separately or simultaneously, according to the requirements of the particular operation.

Fluid film lubrication conditions do not prevail in drawing operations, and nonpolar, nonreactive lubricants, such as mineral oil, were held to have little or no value. Boundary lubrication conditions are encountered, and boundary lubricants are classified as coatings, solid lubricants, reactive lubricants, and polar lubricants. The inability to make distinct categories was pointed out by the author. The combination of various types of boundary lubricants into a single compound is common practice.

Other than separating and slip producing ability, practical drawing lubricants must meet many secondary requirements. The necessity for ease of application, absence of stain and corrosion, removability and similar characteristics of such lubricants were illustrated by actual experiences.

The important role played by the

tool steel is our pride and joy!

Think of tool steel — think of Crucible! That's the reputation we've had for over half a century with our tool steel users. We've never stopped working to maintain our leadership . . . leadership that has kept us the country's *number one* tool steel producer.

Crucible research and development continues to match Industry's need for new and improved tool steels. You can profit from the experience gained by Crucible in the application of tool steels to thousands of uses. Our metallurgical service is freely available to you . . . and our conveniently located warehouses maintain a full supply of tool steels for prompt delivery.

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9″ diameter, 3-colors

CRUCIBLE first name in special purpose steels

TOOL STEELS

52 years of Fine steelmaking

CRUCIBLE STEEL COMPANY OF AMERICA · TOOL STEEL SALES · SYRACUSE, N. Y.

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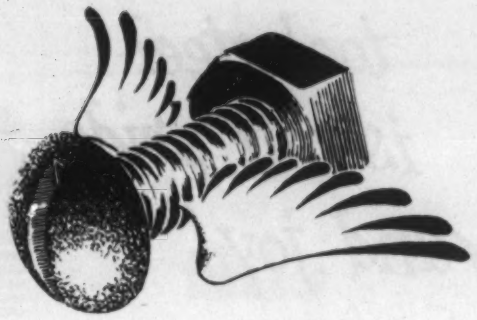

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Anti-Corrosive has millions of stainless fastenings *in stock* (probably the largest selection of varieties and sizes in the world) for *immediate delivery*. Anti-Corrosive has the exceptional production capacity that can fill your requirements beyond stock items faster, *better!*

FREE—A-N Stainless Fastening Selector

This handy slide-chart instantly identifies A-N Nos. pertaining to stainless steel nuts, screws, bolts, rivets, cotter pins, washers; gives sizes and other data. Write for "Chart 52L" TODAY!

25 YEARS OF LEADERSHIP IN FASTENINGS OF STAINLESS STEEL

Anti-Corrosive Metal Products Co., Inc.

Manufacturers of STAINLESS STEEL FASTENINGS

CASTLETON-ON-HUDSON, NEW YORK

News Digest

fats and their derivatives, as drawing lubricants or components thereof, was treated at length. An explanation of the polar activity of these materials was presented. Charts showed characteristics of natural fats and waxes, and products resulting from saponification, sulphonation, and polymerization of fat derivatives. The wide utility of such products was explained by their ability to meet both primary and secondary requirements previously outlined.

While drawing lubricants were emphasized, other cold forming operations, such as cold rolling, were closely related, and most of the information, with respect to fatty type lubricants, could be applied generally. Recent developments in fatty lubricants for cold working were enumerated.

New Ceramic Coating Predicted

America's strategic metal shortage may soon be eased by new ceramic coatings for ordinary steels, allowing their substitution for alloys rich in scarce elements. This prediction was made by John V. Long, director of research of Solar Aircraft Co., at a convention of the Society of Automotive Engineers in Los Angeles.

Long said that coatings are already being produced in quantity for high alloy steels that greatly extend the metal life under high temperature conditions—such as the extreme heat in jet engine operation. These coatings also allow the substitution of alloys containing smaller amounts of the scarce elements than the rich alloys formerly used.

However, up to now scientists have been stumped by the problem of finding coatings for ordinary steels that would allow them to be used in place of the super alloys.

"We are at present test-proving coatings for application to low alloys where fabrications of these metals must work in temperature environments up to 1500 F," Long said.

Mr. Long also stated that large numbers of jet and piston aircraft

Drilling a hidden bull's-eye

...more than a mile underground

Deadeye Dick was a poor marksman, compared to Driller Dan. For the boss tool pusher on a modern drilling rig can hit a target a mile distant, underground, and *'round a bend!*

How does he do it? By using a compass and camera. These, plus a ton – more or less – of drilling tools that enable the compass-camera to tell the truth.

There's no great trick to drilling a hole off center. But to point it where you want, and do it quickly, is something else again.

Before the compass-camera could be lowered for a snapshot, the whole string of tools first had to be pulled out. That was to avoid the effect of magnetism, and it took time. Plenty of time.

Drilling costs can run as much as $5,000 a day. So, someone suggested, why not design a drill collar that *wouldn't* have to be pulled, because it couldn't deflect the compass needle? Why not indeed?

All you needed was to produce a piece of oil well equipment 15 to 22 feet long, about 7 inches in diameter, and weighing in the general neighborhood of a ton. The metal must dampen completely the magnetic field of the drill string and thus enable you to obtain a true magnetic compass reading.

And in addition, this drill collar must provide the rugged mechanical properties called for by rotary rig drilling.

The answer? "K" Monel, one of the heat-treatable, high-strength Inco Nickel Alloys.

Have You a Metal Problem?

Some problems are more *immediate* than others. Some must be resolved tomorrow; some, perhaps, can wait until materials like the Inco Nickel Alloys are readily available again to anyone who wants them.

Whatever your particular problem, our staff of metal specialists is ready to work with you right now to find some metal – whether Inco Nickel Alloy or not – that will help you solve your toughest problem. You can start them working for you by setting down the facts they need to study. Then mail the outline to The International Nickel Company, Inco Nickel Alloys Dept., 67 Wall Street, New York 5, N. Y.

THE INTERNATIONAL NICKEL COMPANY, INC.

Nickel Alloys

Monel® • "R"® Monel • "K"® Monel
"KR"® Monel • "S"® Monel • Nickel
Low Carbon Nickel • Duranickel
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Nimonics

Photograph courtesy of Standard Oil Company (N. J.)

WHEREVER WOOD parts enter your picture specify: GAMBLE BROTHERS

INDUSTRIAL equipment, heavy and light, turns to Gamble Brothers for its hardwood parts . . . hammer boards for drop forges, for instance, or work surfaces, and guide boards. Furniture and cabinet manufacturers, too, have come to recognize the superiority of Gamble Brothers as a source for *ever-dependable* dimension or machined hardwood, solid or laminated, finished or rough.

CALL on the wood-engineering experience of this more-than-fifty-years old firm to help you solve your design and production problems with wood.

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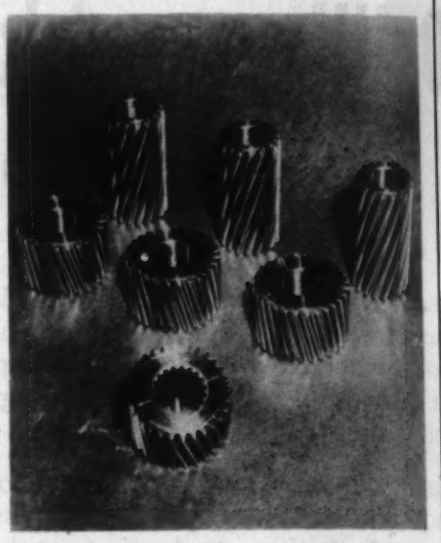
components are being coated with ceramic mixtures, and that civilian products are also being ceramic coated to extend their lives.



Automatic Transmission Parts Case Hardened

Pinions and gears for Buick Dynaflow automatic transmissions are case hardened in a Surface Combustion rotary hearth furnace with radiant tubes and a recirculating fan. Enriched RX prepared atmosphere gas provides active cyaniding medium. The gears, of SAE 4620, are heated to 1550 F in 12-ft dia rotary furnace and quenched in nitrate bath at 410 F. The rated production capacity is about 612 lb per hr of pinions and gears.

Welding Society Plans Spring Technical Meeting in Houston

The American Welding Society has announced plans for conducting a National Spring Technical Meeting at the Shamrock Hotel in Houston, Texas, June 16-19, 1953, accompanied by a four-day Welding and Allied Industry Exposition in the

Helping Hoover lick a dust storm

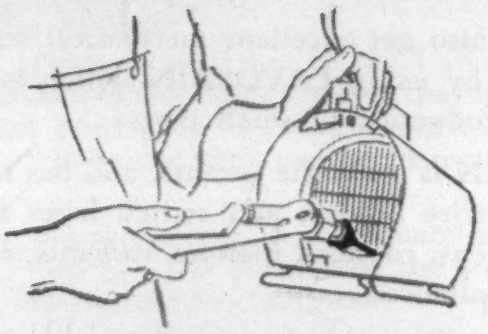
The lady of your house knows more shortcuts than a first sergeant . . . and her favorite target is housework. That's why she and millions of housewives lick household dust and dirt with a vacuum cleaner.

Like any alert manufacturer, The Hoover Company keeps improving and modernizing their product. However, when it came to sealing a filter grid into newly designed housing, all methods failed . . . until they tried a 3M sealer. Now the filter grid withstands a considerable force of air and keeps dirt where it belongs.

Many manufacturers find that the versatility of adhesives and sealers simplifies product improvement, speeds production and cuts costs. They also know that for a quality adhesive and quick, expert service, the company to see is 3M, makers of over 1200 "laboratory engineered" adhesives, coatings and sealers.

See what adhesives can do for you . . .

Call your 3M salesman today and let him show you what adhesives can do for your product! Write also for our 32-page booklet showing successful applications in all industries. Write 3M, Dept. 611, 411 Piquette Avenue, Detroit 2.



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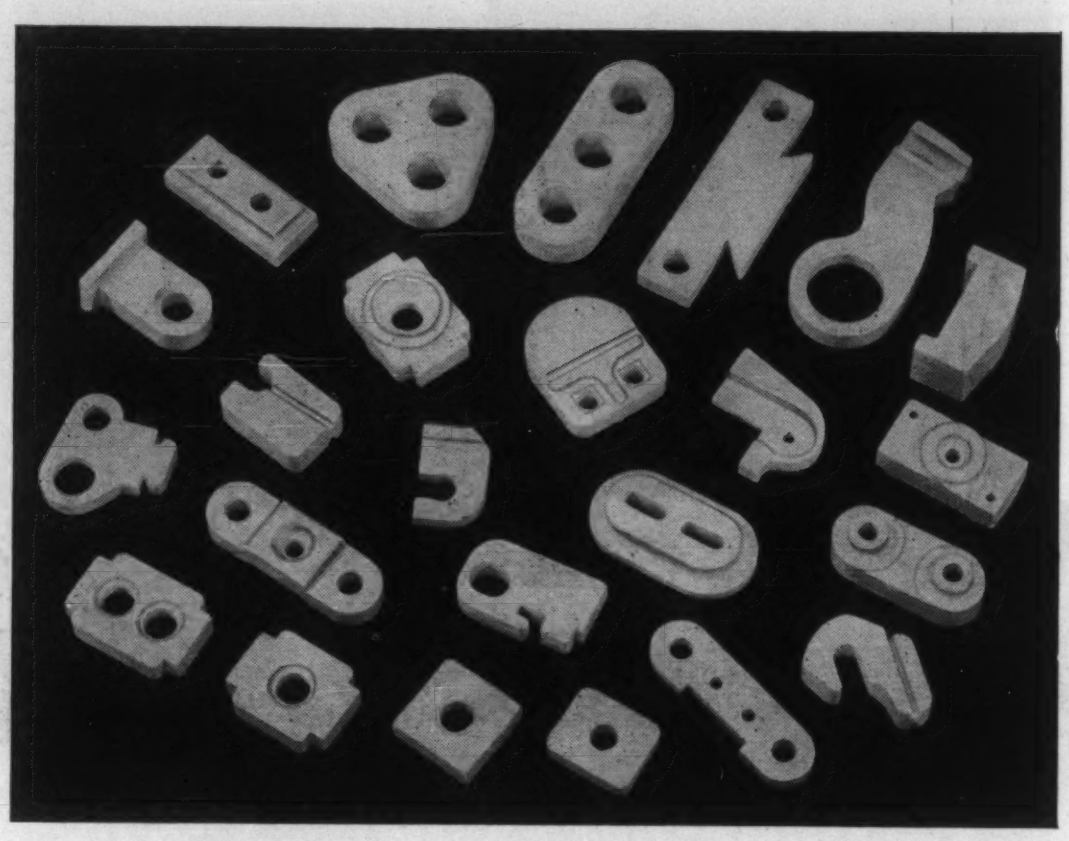


when you want good dielectric strength at high temperatures in

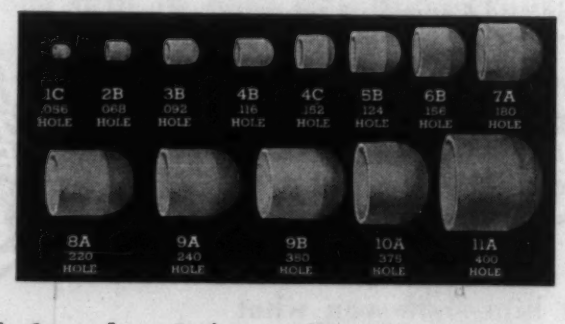
SMALL PORCELAIN PARTS

You will also get excellent mechanical strength and good thermal shock resistance by using LAVOLAIN which is designed for economical, high volume production of small parts.

LAVOLAIN is a steatite ceramic and has found wide use as rods, bushing, resistance-wire holders and switch bases for a wide range of products—electric ovens, roasters, toasters, radiants, rheostats, immersion heaters and similar appliances.

STAR INSULATING BEADS

Ball and socket type for insulating bare wire. Heat resistant. High dielectric strength. Low cost. Quickly applied. 13 stock sizes. Cut shows beads approximately half size.



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The STAR PORCELAIN COMPANY

MUIRHEAD AND JAY AVES. TRENTON, N. J

News Digest

Shamrock Hall of Exhibits, adjoining the Hotel.

The welding industry has frequently stressed the need for taking welding engineering demonstration and display to industrial centers other than the cities of the Society's National Fall Meeting pattern. The growth of welding engineering has also caused an increased supply of papers of technical interest and production value.

The technical program will include papers and symposia on welding and allied subjects of national and regional aspect and technical treatise subjects of interest to the specialized industry of the Southwest; the aircraft, the oil, chemical, shipbuilding, etc. The time, June 16-19, 1953, was selected to avoid interference with other industrial and technical meetings in the Southwest.

NACA Publishes Research Reports

The National Advisory Committee for Aeronautics recently published a number of research reports of interest to materials engineers. Copies of these reports are available from the NACA, 1724 F St., N. W., Washington 25, D. C.

"Stress and Strain at Onset of Crazing of Polymethyl Methacrylate at Various Temperatures." M. A. Sherman and B. M. Axilrod, National Bureau of Standards (NACA TN 2778). Stress and strain at the onset of crazing were determined for both general-purpose and heat resistant grades of commercial cast polymethyl methacrylate. Tests were made at 73, 122 and 158 F on samples 0.15 in. thick. Other properties measured were tensile strength, total elongation, and modulus of elasticity. Results obtained indicate that a "critical-strain theory" for the threshold of crazing is not applicable to polymethyl methacrylate. Strain at the onset of crazing decreased with increase in temperature from 73 to 122 F, whereas there was no consistent trend from 122 to 158 F. Stress at the onset of crazing was about 80 to 95% of

(Continued on page 210)

The Steel that took the cussing out of changing an "Alligator's" Teeth

● Deep in the coal mines, mechanics had the knuckle-busting job of loosening the worn set-screws that hold coal-cutting bits in the endless chain of mechanical coal-mining machines . . . or "alligators". The grinding abrasion of coal and rock quickly wore off the square heads to round heads.

The Bowdil Company makes most of the cutter chains used on leading makes of coal-mining machines. They asked Republic Steel for a solution to the problem of the round heads on the "alligator".

A Republic Field Metallurgist recommended that Bowdil switch to a Republic *Carbon-corrected* Cold Drawn Alloy Steel Bar for the set-screws. They did . . . and there's been less cussing in the coal mines . . . plus a great reduction in the amount of high-priced time wasted in trying to get a grip on worn set-screws.

Carbon-correction produces long-wearing qualities in the square alloy steel bars right out to the corners . . . prevents the corners of the stock from turning up soft while the center has the desired hardness.

May we tell you more about Republic *Carbon-corrected* Cold Drawn Alloy Steels? And how Republic Three-Dimension Metallurgical Service helps manufacturers work these steels into their production? A letter will bring the Republic Field Metallurgist to call.

Republic Carbon-corrected Cold Drawn Alloy Steels make the square heads of these set-screws tough right out to the corners to withstand wear longer without rounding off.

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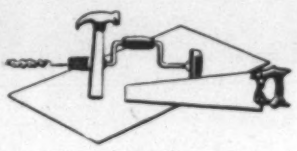
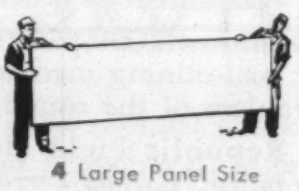

2 Workability

3 Cross Laminated Strength


4 Large Panel Size

5 Tested Quality

6 Light Weight

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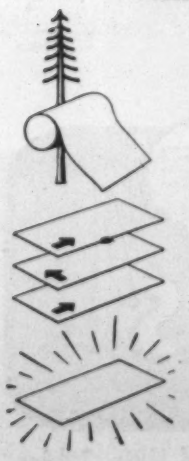
Add this to plywood's many other advantages and you'll see why it is preferred for fixtures and furniture . . . paneling and cabinets . . . displays and partitions . . . siding and signs. No other building material does so many jobs so well.

For further information, write Douglas Fir Plywood Association, Dept. 4611, Tacoma 2, Washington.



Douglas fir plywood is real wood, made by "unwinding" giant logs

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to form large, light panels having beauty and great strength

Douglas Fir Plywood

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News Digest

the tensile strength at all three temperatures.

"Corrosion and Fatigue Tests on Magnesium Alloys Treated by a Frasch Galvanic Process." H. G. Cole (RAE Tech. Note Met. 156). The Frasch galvanic process, carried out in a solution of zinc dichromate containing a small amount of free chromic acid, gave good protection to three types of magnesium alloy and provided an excellent base for paint. Neither the Frasch galvanic process nor the RAE electrolytic chromate treatment caused any significant reduction of fatigue strength of magnesium alloy extruded bar to D.T.D. 259. Chromate treatment in the RAE hot half-hour bath caused an increase in fatigue strength.

"Wear and Sliding Friction Properties of Nickel Alloys Suited for Cages of High Temperature Rolling-Contact Bearings. I—Alloys Retaining Mechanical Properties to 600 F." Robert L. Johnson, Max A. Swikert and Edmond E. Bisson. (NACA TN 2758). Wear and sliding friction properties of a number of nickel alloys operating against hardened SAE 52100 steel were studied. These alloys include "L" nickel, wrought monel, cast monel, cast modified "H" monel, cast "S" monel, Invar, Ni-Resist 3, and Nichrome V. Some of the alloys studied may be useful as possible cage material for high temperature, high-speed bearings for aircraft turbines or for bearings to operate in corrosive media. Desirable operating properties of all the materials could be associated with the development on the rider surface of a naturally formed film of nickel oxide. On the basis of wear and friction properties, Ni-Resist 3, modified "H" monel and Invar were the best materials studied in this investigation although they did not perform as well as nodular iron. "L" nickel performed well with light loads but was not effective at higher loads when the surface film broke down.

"Wear and Sliding Friction Properties of Nickel Alloys Suited for Cages of High Temperature Rolling-Contact Bearings. II—Alloys Retaining Mechanical Properties above 600 F." Robert L. Johnson, Max A. Swikert and Edmond E. Bisson. (NACA TN 2759). Wear and sliding friction properties of a number of nickel alloys operating against hardened

Baldwin SR-4® strain gauges are shown cemented to the panel between cylinders of an eight-cylinder diesel engine frame. The numbers on the gauges correspond to numbers shown in the oscillogram.

To see what happens to a diesel engine frame in operation

The magnitude and direction of rapidly shifting stresses in the frame of an operating diesel locomotive engine can tell a lot about performance and service life.

Baldwin-Lima-Hamilton engineers, to measure these forces, attached sensitive SR-4® strain gauges to an engine frame. The resulting photorecorded oscillograms, made with the engine in operation, provided the detailed information they required.

The oscillogram shown here represents less than two seconds of time. Yet, photography captured the fastest-moving traces and preserved all the detail for careful study and permanent reference.

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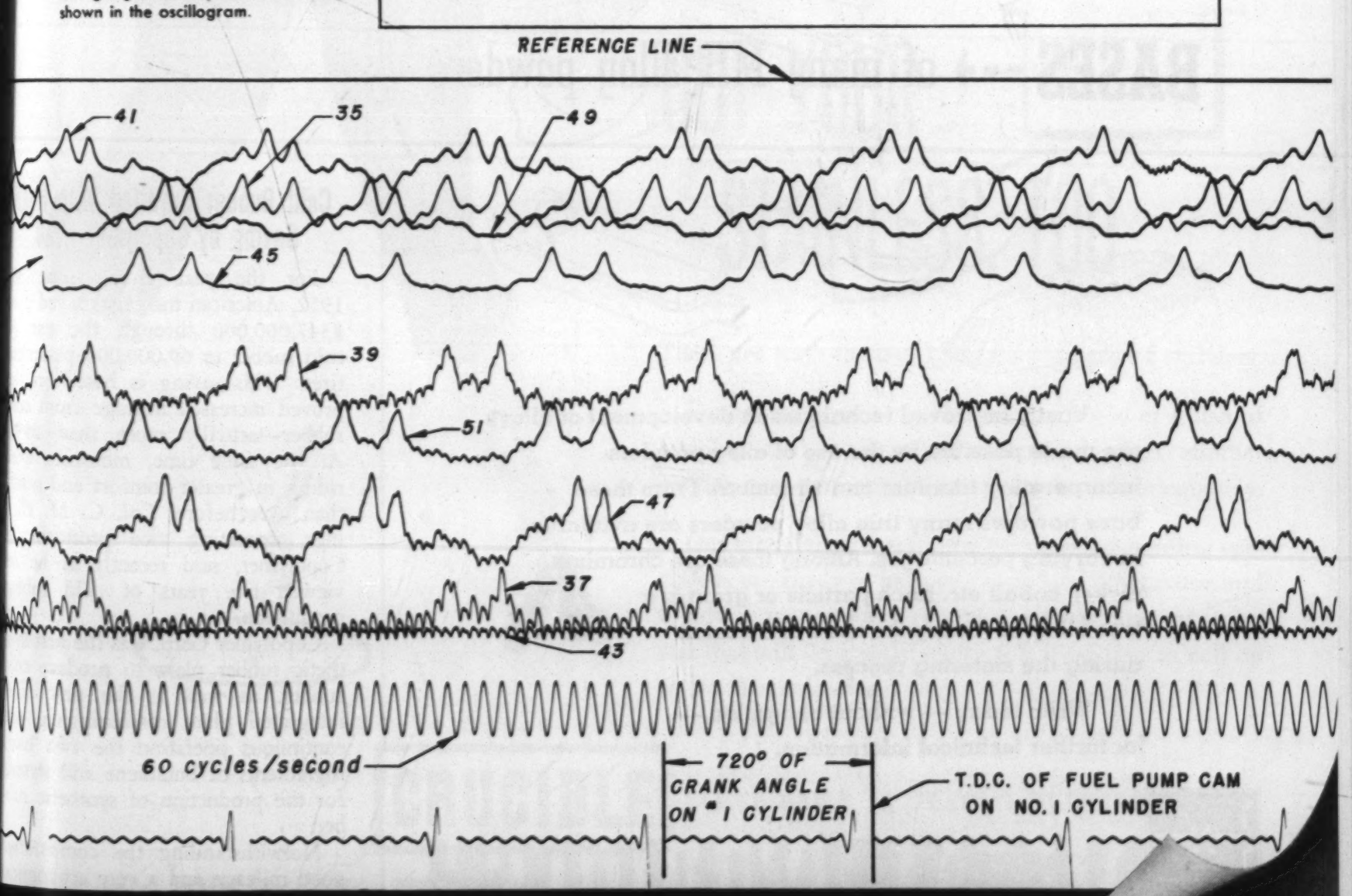

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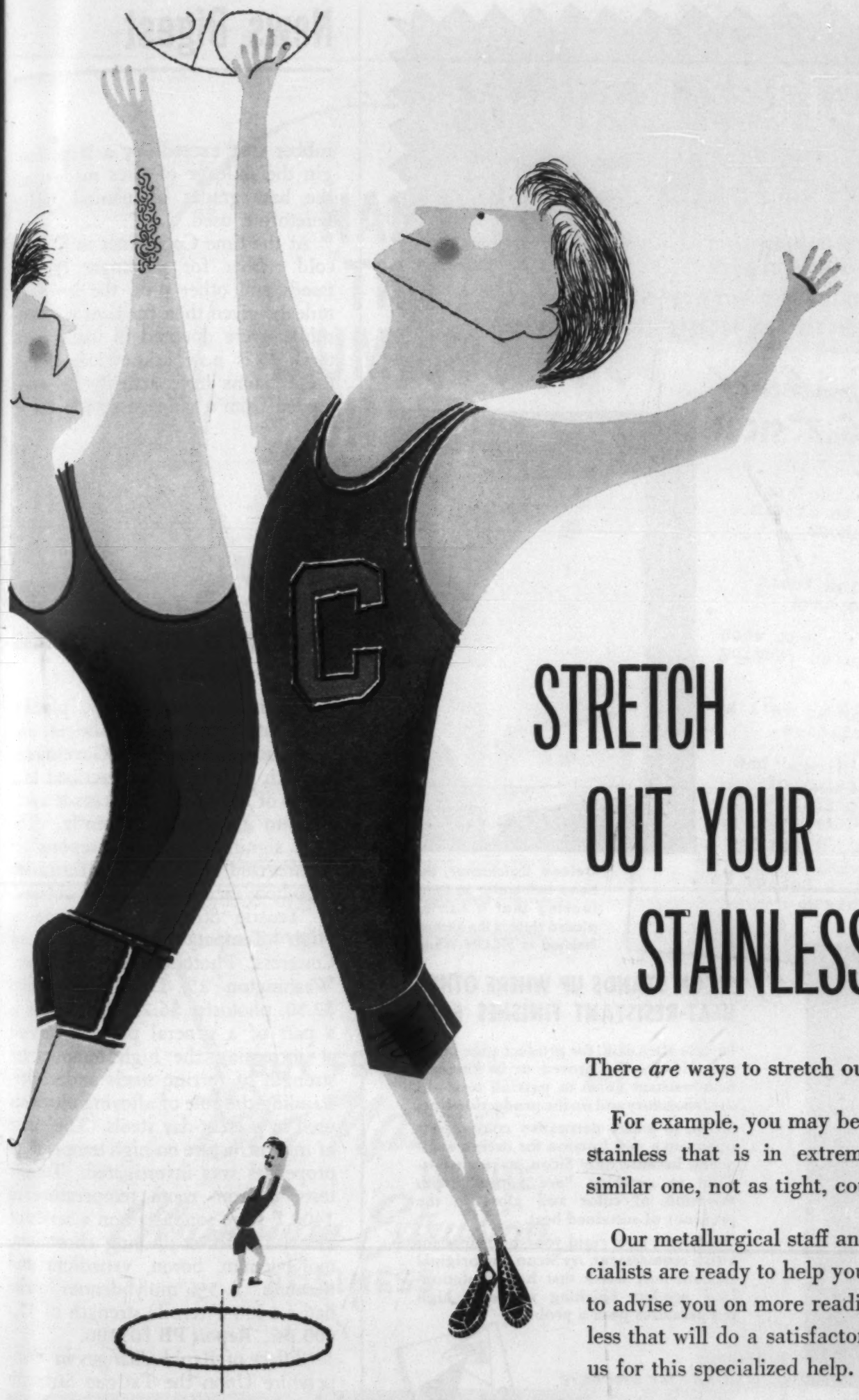
SAE 52100 steel were studied. T alloys were cast beryllium nickel, he treated beryllium nickel, cast Incon Nimonic 80, Inconel X, Refractall 26, and Discaloy. Some of the allo studied may be useful as material f cages of rolling-contact bearings th operate at high speeds with temper tures above 600 F in projected ai craft turbine engines or for bearing that operate in corrosive medium Desirable operating properties and th absence of extreme mass welding all the materials studied could be a sociated with the development of th sliding surfaces of a naturally i formed film of nickel oxide. On th basis of wear and friction propertie cast Inconel performed very well i these experiments and compares f vorably with nodular iron. Nimon 80 also showed promise as a poss ble cage material.

Cold Rubber Credited with Huge Saving by Copolymer Head

For the year ended June 30, 1952, American motorists saved over $347,000,000 through the use of cold rubber in 69,000,000 passenger tires. This saving is based on the proved increased mileage from cold rubber—actually more than 25%. At the same time, motorists were riding in greater comfort and safety than ever before, Col. C. M. Hulings, operating vice president of Copolymer, said recently as he reviewed five years of cold rubber production.

Copolymer Corp. was the first synthetic rubber plant to produce cold rubber, as well as the first dual-integrated plant combining in one continuous operation the two basic ingredients of butadiene and styrene for the production of synthetic rubber.

Notwithstanding the comparative good mileage and a very economical tire cost per mile previous to the advent of cold rubber, today a new standard of passenger tire mileage has been established through cold



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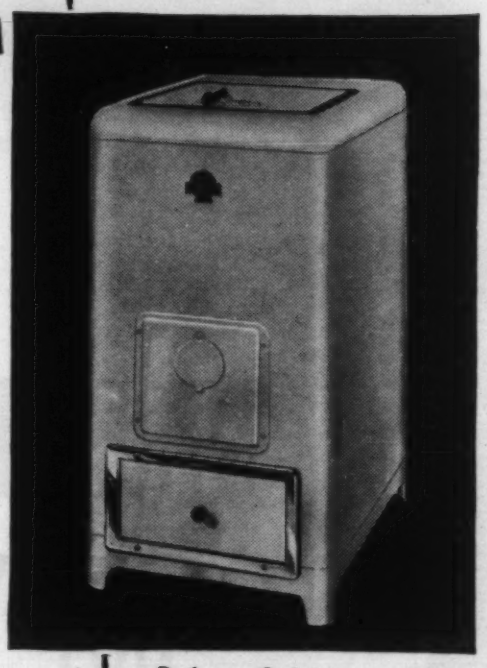
2. Exceptional color as well as gloss retention qualities.

In addition, only 'Sicon' had good inherent qualities of adhesion and film stability."

W.M. Milbourne, Sales Mgr., Calcinator Division Valley Welding & Boiler Co., Bay City, Michigan



Deluxe Calcinator, the home incinerator so smart looking that it can be placed right in the kitchen. Finished in *SICON* White.

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No matter how rigid your heat-resistant finish requirement, *try* Sicon, the original silicone-base finish that has revolutionized product finishing wherever high temperatures pose a problem.

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rubber that exceeds by a large margin the mileage of tires made from the best grades of natural rubber heretofore used.

At the time Copolymer introduced cold rubber for passenger car tire treads and other uses, the increased mileage given then for tires with this rubber were doubted in many quarters. It is now acknowledged that these claims have actually been exceeded from a mileage standpoint.

Department of Commerce Technical Reports Available

Advances in metallurgy, plastics, lubricants, corrosion additives and ceramics resulting from Government research activities are described in a group of technical reports made available to the public recently. The most significant of these reports are summarized below, with information as to how each report can be obtaned.

"Tensile Strength of Ferrite at High Temperature." Library of Congress, Photoduplication Section, Washington 25, D. C. Microfilm $2.50, photostat $6.25. The study is a part of a general program aimed at increasing the high temperature strength of ferritic steels and understanding the role of alloying elements used in present-day steels. The effect of microstructure on high temperature properties was investigated. Tensile tests at from room temperature to 1400 F were conducted on a series of binary ferrites containing chromium, molybdenum, boron, vanadium and titanium. A 5% molybdenum ferrite had a 1400 F tensile strength of 17,000 psi. Report PB 107100.

"Effect of Rapid Changes in Temperature Upon the Fatigue Strength of a Light Alloy Used in Aircraft Construction." Library of Congress, Photoduplication Section, Washington 25, D. C. Microfilm $2.25, photostat $5.00. An investigation was made to determine the effect of rapidly changing temperatures on 24S-T aluminum sheet undergoing bending stresses in fatigue while the temperature was varied. The results showed an increased resistance to fatigue un-

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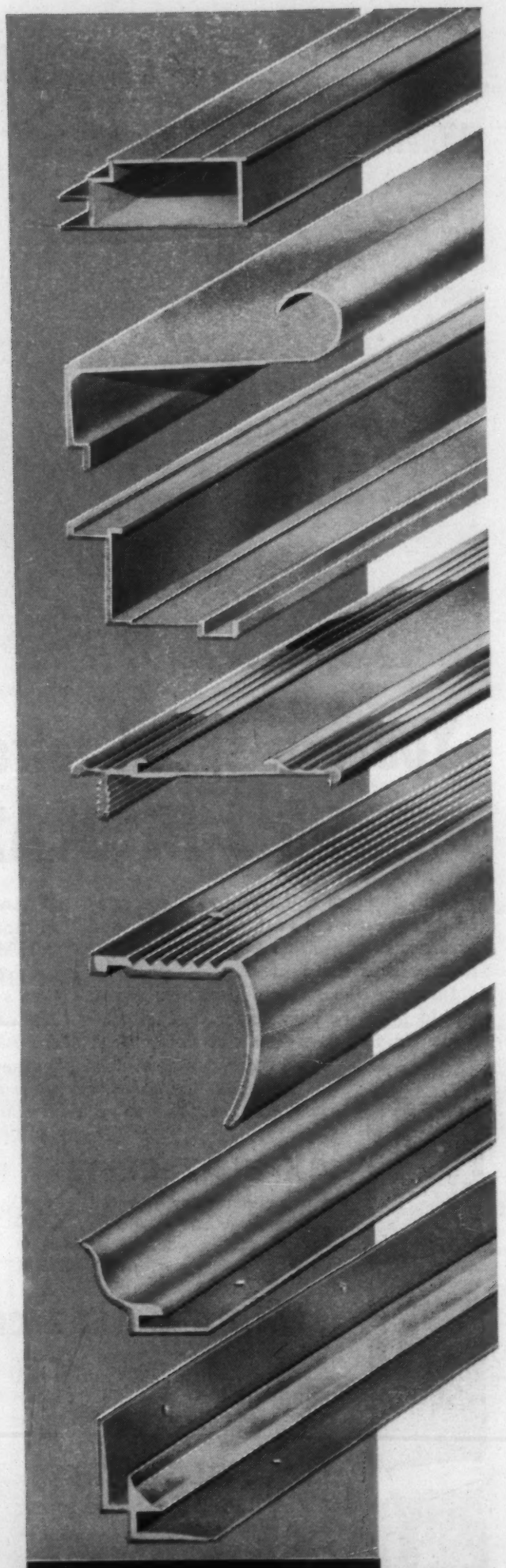

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You can speed refractory repairs with J-M BLAZECRETE

You'll find Johns-Manville Blazecrete* ready at a moment's notice to quickly and economically build new refractory linings or repair old ones.

Just mix Blazecrete with water, as you would mix ordinary concrete, then gun it on or slap-trowel it on. Either way, Blazecrete goes on fast . . . there's no *laborious ramming or tamping.* When gunned, it adheres readily with a minimum of rebound loss.

You'll find Blazecrete a hydraulic setting refractory that will not harm workmen's hands. It is furnished as a dry mix, and can be stored indefinitely. To meet the requirements for various operating temperatures, Johns-Manville developed *three types* of Blazecrete . . . and each is available for prompt delivery:

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For temperatures through 3000F. Unusually effective for heavy patching, especially where brickwork is spalled or deeply eroded. Excellent for building and repairing forge furnace linings, burner blocks—and for lining ladles in ferrous and nonferrous foundries.

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All Blazecrete products harden on air curing . . . can then be fired or left standing indefinitely. For further details, send for Brochure RC-28A. It also tells about Blazecrete's companion material, Firecrete* . . . the hydraulic setting castable refractory for making special shapes and linings. Just write Johns-Manville, Box 60, New York 16, N. Y. In Canada, 199 Bay Street, Toronto 1, Ontario. *Reg. U. S. Pat. Off.

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der a constant low temperature condition. Code No. of Report, PB 107101.

"High Frequency Heating and Temperature Distribution in Surface Hardening of Steel." Royal Swedish Academy of Engineering Sciences. Library of Congress, Photoduplication Section, Washington 25, D. C. Microfilm $4.75, photostat $15.00. A general survey of surface hardening methods and problems is followed by discussions of eddy currents in ferromagnetic conductors having a redhot nonmagnetic outer zone enveloping a magnetic core at lower temperatures, surface heating of pieces of great specific thickness (heat flow in one dimension), and surface heating of pieces of small specific thickness. Report PB 107109.

"Fiberglas Reinforced Plastic Pressure and Fuel Vessels for Flame Throwers." U. S. Chemical Corp. Library of Congress, Photoduplication Section, Washington 25, D. C. Microfilm $1.75, photostat $2.50. Treats: Flame throwers, portable—pressure vessels, fuels; flame thrower—pressure vessels; fiberglas—thermal properties; resins—esters; resins, Polyester—Use to reinforce fiberglas. Report PB 107008.

"Directions for Machining Plexiglas." Rohm & Haas G. mb. H., Darmstadt, Germany. (Text in German). Library of Congress, Photoduplication Section, Washington 25, D. C. Microfilm $1.75, photostat $2.50. Report PB 40060.

"Characterization of Monochlorotrifluoroethylene Polymers." Union Carbide and Carbon Corporation. Library of Congress, Photoduplication Section, Washington 25, D. C. Microfilm $3.50, photostat $10.00. Investigations conducted to characterize the nature of monochlolorotrifluoroethylene polymers (fluorothene) with particular reference to their usefulness as wire coating and molding materials. Of greater significance is the fact that its modulus of elasticity of stiffness increases only gradually over a very wide temperature range. This results in a material which does not shatter readily at temperature as low as —328 F and which resists flow under low to moderate loads at temperatures as high as 392 F. The outstanding electrical resistivity under conditions of high temperature, high humidity, and in contact

HEAT TREATING MATERIALS . . . SINCE 1911

Park Chemical Company

BY THE *Research Laboratory* OF THE PARK CHEMICAL CO.

DETROIT 4, MICHIGAN

Tests Show New Quench Oil has Intensified Triple Action

PARK'S Triple A Quench Oil has intensified triple action: 1. Rapid heat removal with faster cooling rate in the critical range giving higher and deeper hardness. 2. Slow cooling through the hardening range, minimizing distortion. 3. Great stability due to special anti-oxidants. Result is longer life and bright quenching properties.

An explanation of the quenching process illustrates how Park Chemical Company with over forty years of chemical and metallurgical background developed an ideal oil to fit the ever mounting production quenching problems.

Three stages of cooling are observed when steel is quenched in oil from a red heat. (A) Formation of a vapor film at the steel surface; cooling is accomplished by conduction and radiation through this vapor film and is relatively slow. (B) Direct contact of the oil with the metal surfaces causing a boiling action which continually dissipates the vapor film formed and results in rapid cooling. (C) After the metal has been cooled to the boiling point of oil, vapor is no longer formed; cooling is by conduction and convection, and the metal slowly cools to the temperature of the oil.

Although water and water solutions provide high cooling rates throughout these three stages of quenching, they are often impractical because rapid cooling is not desirable in the lower ranges of temperature where martensite is formed. It is at this time that temperature differentials within a piece of steel cause warping and cracking. Thus oil quenching is preferred for all steels possessing sufficient hardenability to avoid transformation to soft structures in stages A and B, since the cooling rates furnished by oils during Stage C are ideal for preventing temperature differentials.

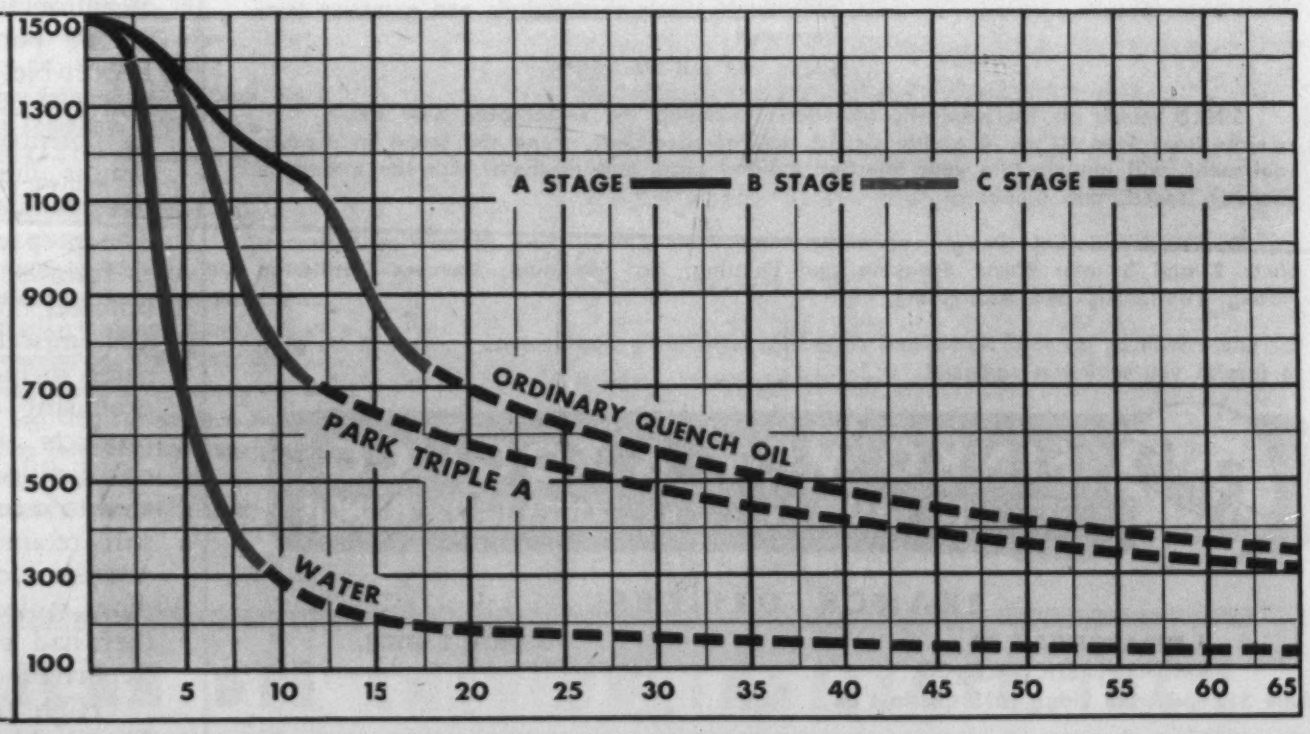
It is apparent that any improvement in the cooling power of oil in Stages A and B would be most desirable. Such improvement is obtained in water quenching by the addition of salt or caustic soda. The brine or caustic solution has a wetting action which completes the quenching job faster than fresh water. Fresh water takes hold only in spots causing non-uniformity. Brine solutions provide deeper and more uniform hardnesses. It seems logical to attempt to do this same thing with oil. The mineral intensifiers added to Park's Triple A Quenching Oil act in this manner.

The accompanying cooling curves serve to illustrate how this additive has altered the quenching power of the oil in the A and B stage, yet has retained the desirable slow cooling in the C stage.

This is the front page of a 4 page Technical Bulletin on Oil Quenching. For the complete bulletin write for Bulletin F-8.

A, B, C, stages in cooling curves showing advantages of Park Triple A Quench Oil. Samples quenched from 1500° F. in oil at 140° F. and water at 70° F. Steel SAE 1045 ½" dia. x 2" long.

Note: *Chart is plotted in degrees F. on the ordinate and time in seconds on the abscissa.*



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News Digest

with corrosive chemicals, makes fluorothene of extreme interest for wire insulation and other electrical insulating applications. Fabrication of these resins by extrusion and molding were studied in considerable detail. Report PB 106996.

"Pinic Acid Diesters; Their Preparation, Properties and Lubricant Applications." U. S. Naval Research Laboratory. Office of Technical Services, U. S. Dept. of Commerce, Washington 25, D. C. Mimeo: $.75. The preparation and properties are reported for a new class of diesters prepared from pinic acid and normal alcohols containing from 4 to 10 carbon atoms. Lubricating oil compositions have been developed which establish the suitability of the dialkyl pinates for a wide variety of applications. Excellent pinate-base greases have also been prepared. The commercial development of pinic acid at low unit cost from alphapinene is eminently desirable as it is potentially available in large supply from turpentine—a native raw material. In addition to its use in synthetic lubricants, this dibasic acid has excellent possibilities for the synthesis of low-temperature plasticizers, polymers, resins and fibers. Report PB 111019.

"Organo-Phosphorus Compounds." Technical Report No. VI, Period Sept. 1, 1950 to Nov. 30, 1950. Shell Development Co. Library of Congress, Photoduplication Section, Washington 25, D. C. Microfilm $2.50, photostat $6.25. Technical Report No. VI discusses the preparation and evaluation of phosphonates as potential lubricants and/or hydraulic fluids, to the exclusion of phosphinates and phosphine oxides. The preparations of this period are as follows: phosphine oxides; phosphinates, phosphonates, phosphates, and miscellaneous. The phosphonates include repeated syntheses of promising compounds as "bottoms-products", that is, the materials were not distilled. The latter were evaluated to ascertain whether or not they still retained their favorable characteristics on elimination of the tedious molecular distillation to which they had previously been subjected. Report PB 107159.

"High Temperature Lubrication of Electric Motor Ball Bearings." U. S. Naval Research Laboratory. Office of

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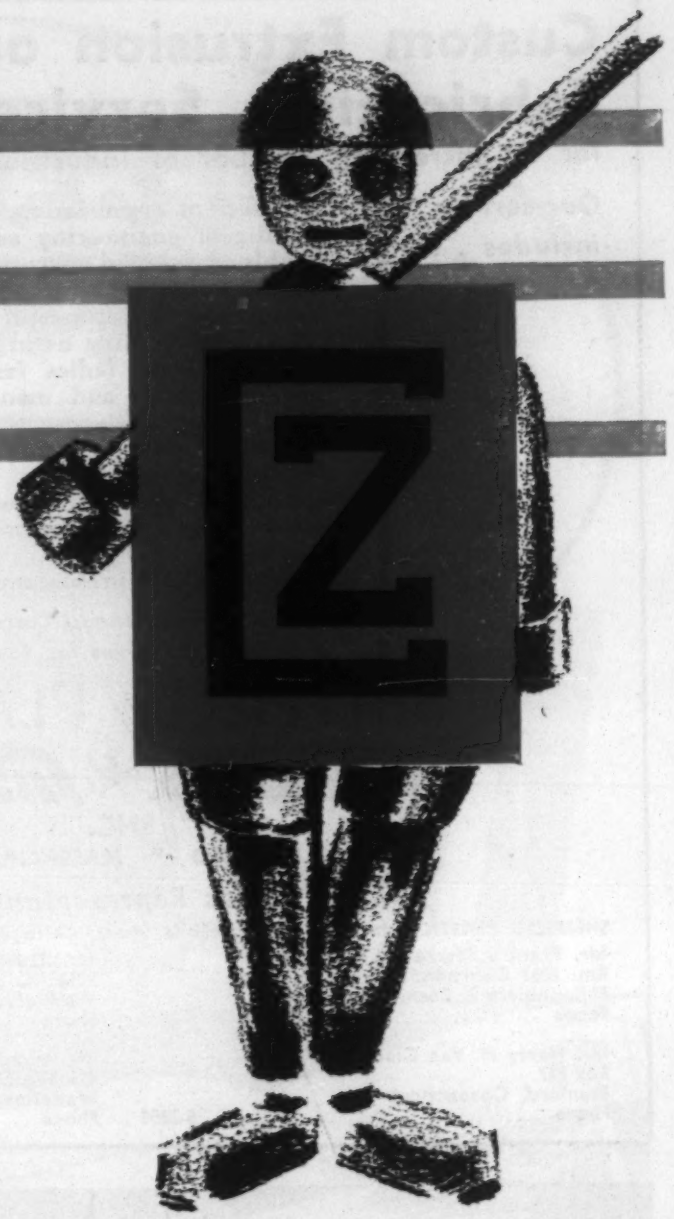

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Kamin Die Casting & Mfg. Co., Chicago, Ill.
Kiowa Corporation, Marshalltown, Iowa
Paul Krone Die Casting Co., Chicago, Ill.
Madison-Kipp Corporation, Madison, Wis.
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Monarch Aluminum Mfg. Co., Cleveland, Ohio
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Paragon Die Casting Company, Chicago, Ill.
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Precision Castings Company, Inc., Cleveland, Ohio
Precision Castings Corp., Chicago, Ill.
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Racine Die Castings Co., Racine, Wis.
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News Digest

Technical Services. U. S. Dept. of Commerce, Washington 25, D. C. Mimeo: $2.25. The 5-year program just completed was aimed at the development of greases and ball bearings suitable for lubricating electric motors at bearing temperatures from —40 to 302 F. New or improved methods for laboratory testing of greases and for bench testing of motor ball bearings were evolved for use at 302 F. Nine newly developed greases (all of which are now commercially available) were investigated. These included a mineral oil-diester blend gelled with lithium soap, a polyalkylene glycol derivative gelled with carbon black and the others with lithium soaps. Only the silicone-lithium soap greases were useful at 302 F for over 100 hr of operation without regreasing. Lowering the temperature to 257 F resulted in a large increase in the life of all greases tested; the silicone-soap grease having a clear advantage over all the others. However, several nonsilicone greases gave dependable operation at 257 F for 1000 to 2000 hr without regreasing. For operation at 212 F the three soap-gelled silicone greases and three of the nonsilicone greases gave 10,000 to 15,000 hr of satisfactory operation without relubrication. Report PB 111015.

"Corrosion Preventive Additives." Final Report. Armour Research Foundation. Library of Congress, Photoduplication Section, Washington 25, D. C. Microfilm $2.00, photostat $3.75. A dependable test for ball bearing corrosion in instrument oils was developed and data on the basic corrosion mechanism were obtained. Work was also begun on the fractionation of petroleum sulfonates, and present indications are that the corrosive effect can be attributed to a particular fraction of these sulfonates. Report PB 107169.

"Manufacture of Titanium Alloys." Final Report for Period Aug.3, 1950 to Dec. 31, 1951. Library of Congress, Photoduplication Section, Washington 25, D. C. Microfilm $4.50, photostat $13.75. The melting, casting of ingots, forming, metallography and properties of experimental melts of titanium and its alloys are compared. Titanium alloys with silicon, manganese, aluminum, vanadium, chromium and iron were prepared. Small silicon additions were found to be beneficial in increasing

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News Digest

strength and resistance to air and nitrogen at elevated temperatures. Material in cold rolled sheet form containing vanadium was strong, ductile and more bendable than other alloys tested. Aluminum-iron and vanadium-iron alloys of titanium are hardenable by quenching from forging temperatures. Report PB 107150.

"Data Book of Steels." U. S. Munitions Board. Available from Library of Congress, Photoduplication Section, Washington 25, D. C. Microfilm $2.25, photostat $5.00. The tabulations presented are intended as a reference to illustrate the various classes of steel, their composition, physical characteristics and applications. Report PB 107178.

"Injection Molding of L-5 Ceramics." Stupakoff Ceramic & Manufacturing Co. Library of Congress, Photoduplication Section, Washington 25, D. C. Microfilm $4.50, photostat $13.75. Report dwells on auxiliary agents in particular, rather than on a description of the processes as such. Report is divided into four major parts, namely introduction, binders and plasticizers, miscellaneous low-loss body investigations (see PB 104096-PB 104012, PB 107167-107168); for final report see PB 107015 and 107015s. Report PB 107015.

"Injection Molding of L-5 Ceramics." Final Report. Stupakoff Ceramic & Manufacturing Co. Library of Congress, Photoduplication Section, Washington 25, D. C. Microfilm $3.50, photostat $10.00, Treats: L-5 (plastic) — molding, injection; dies, injection molding—design; cellulose, ethylether—Use in injection molding. Report PB 107015.

"Electrical Properties of the Inorganic Papers." U. S. Naval Research Laboratory. Office of Technical Services, U. S. Dept. of Commerce, Washington 25, D. C. Mimeo: $.25. The electrical properties of asbestos, mica, ceramic, glass and silica fiber papers have been studied for possible use as thermally stable insulants. The electrical losses are lowest in the synthetic-base papers and highest in the asbestos products. Report PB 111017.

"Rain Erosion Properties of Plastic Materials, Supplement 1: Design and Construction of Laboratory Testing Devices for Accelerated Comparison of Rain Erosion Resistance of Plastic Materials." U. S. Air Material Com-

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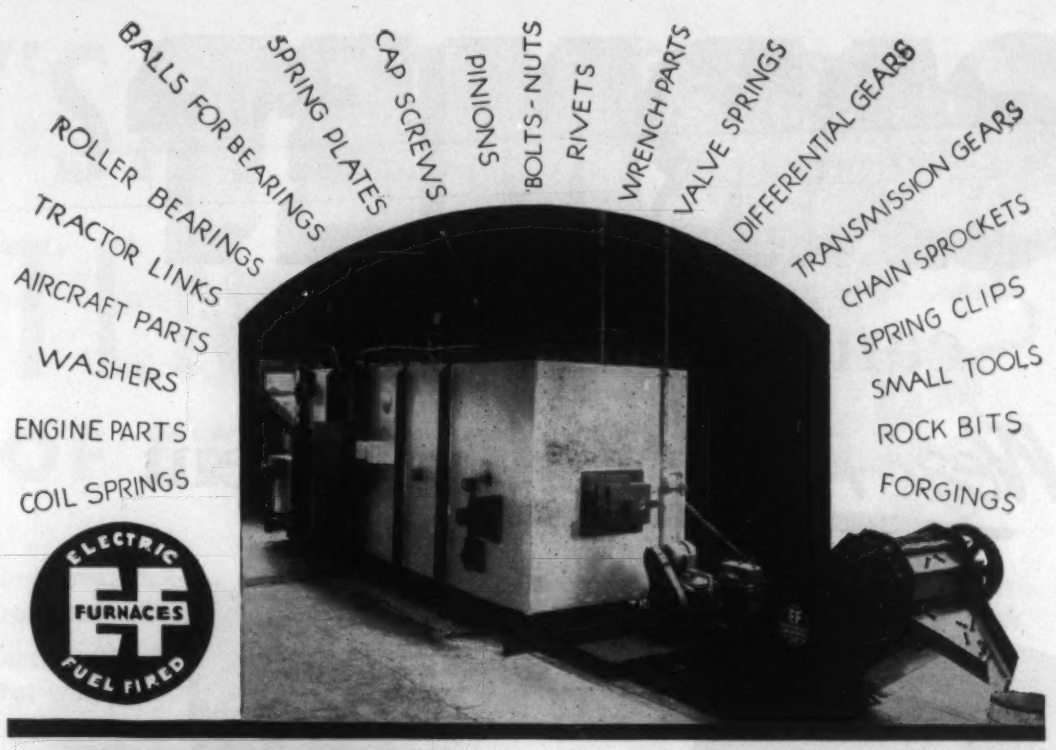

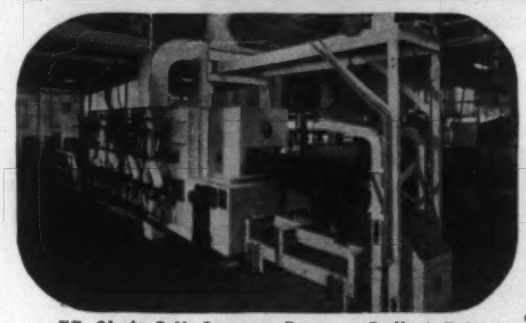

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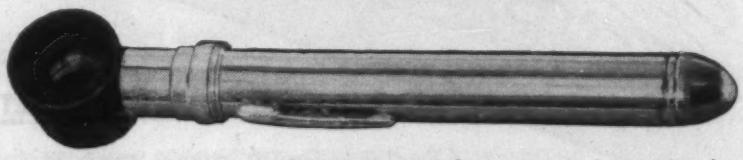

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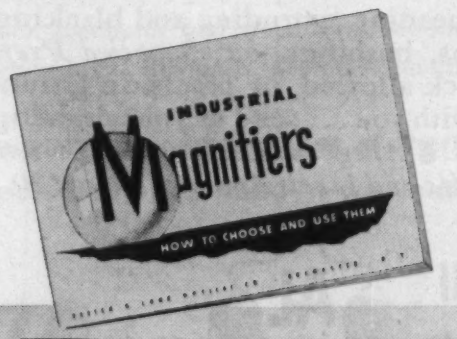

BAUSCH & LOMB *Magnifiers*

News Digest

mand. Library of Congress, Photoduplication Section, Washington 25, D. C. Microfilm $2.25, photostat $6.25. A magnetostriction oscillator was constructed similar in principle and design to apparatus used for testing the cavitation erosion resistance of metals for marine propellor use. It consists essentially of a 10-kilocycle magnetrostriction oscillator with a power output of approximately 200 watts. One-quarter wave of the half-wave 10-kilocycle magnetrostriction rod is electro-magnetically active while the other quarter wave section is excited by reflected energy. The plastic test specimen is attached by bonding with a thermoplastic adhesive to the end of the latter quarter wave rod section. The apparatus has not been completely evaluated as yet as a rapid laboratory tester for determining the relative rain erosion resistance of plastic materials. Report PB 97575s.

News of Engineers

Harry C. Martin, director of research and development of The Carborundum Co., has been elected a vice president of the company. He will continue active direction of the company's research and development activities, and will serve as principal advisor to the president on all technical matters.

T. H. Wickenden, vice president in charge of development and research of The International Nickel Co., Inc., has been elected a member of the Welding Research Council of the Engineering Foundation for a three-year term.

Wilbur Gardner, secretary and treasurer of DeWalt Inc., has been elected a vice president of the power cutting tool manufacturing subsidiary of American Machine & Foundry Co.

According to a recent statement from R. M. Hollingshead Corp., *Raymond Le-Kashman* has been appointed manager of the Automotive Div.

The Permutit Co. has announced the addition of *Felix W. Saco* to its Mechanical Engineering Dept.

Harold A. Burnip has been appointed director of purchase engineering for The Lincoln Electric Co. As head of purchase engineering, Mr. Burnip will be

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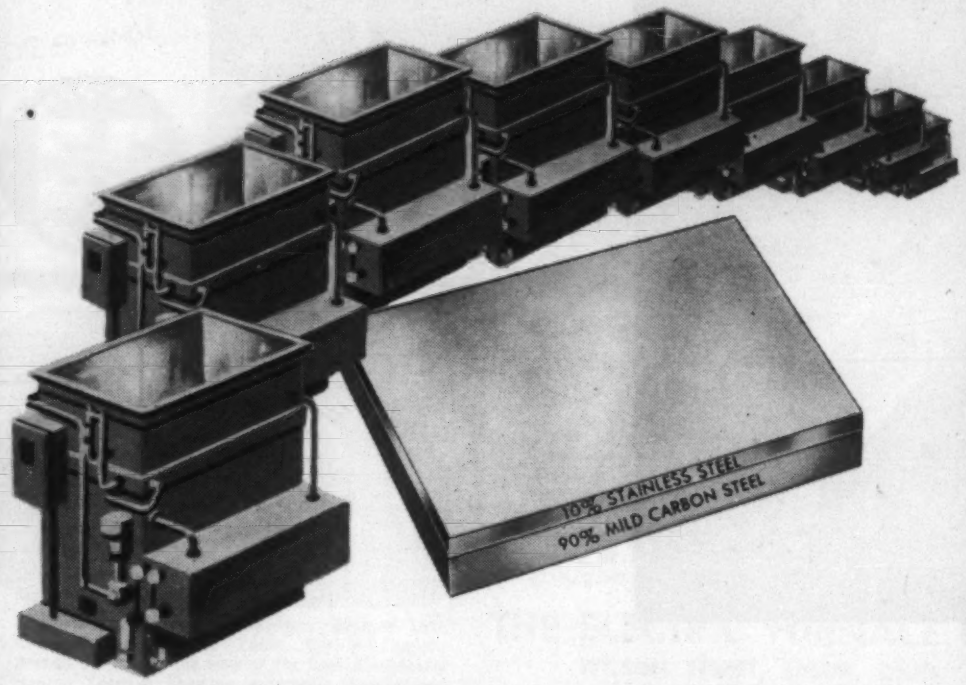

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News Digest

responsible for developing new materials, lower cost substitute materials, establishing purchasing and quality control specifications, and either new or improved processes and methods to permit the better and more economical manufacture of welding equipment.

Val L. Follo, in charge of production of the U. S. Navy's famed Corsair fighter plane in Goodyear Aircraft Corp.'s Plant D during World War II, has been returned to the company in the capacity of factory manager, while *C. H. Zimmerman* has been called upon to guide the company's increased and intensified production programs in the wheel and brake, rocket and Wingfoot Lake Divs.

Key management assignments of the Goodyear Atomic Corp., subsidiary of The Goodyear Tire & Rubber Co., which will operate the government's new atomic energy installation, have been announced as follows: *Albert J. Gracia*, manager of operations; *James A. Merrill*, manager of the laboratories; *D. H. Francis*, manager of development engineering; *George H. Reynolds*, manager of production; *W. A. Brown*, staff engineering and maintenance; *Hugh C. Hilliard*, industrial relations.

The election of *A. Lehr* as vice president of Bliss & Laughlin, Inc., has been announced.

The following appointments have been announced by Bowser Technical Refrigeration, Div. of Bowser, Inc.: *Jack Shamroth*, vice president; *Thaddeus Augustyn*, production manager; *Norman Miller*, chief engineer, was named to head the Drafting Dept., with *Carl Schechtman* as chief draftsman; *William H. Miller*, chief metallurgist.

Carl R. Sare, formerly assistant to the president of the Patterson Foundry & Machine Co., has been elected vice president of W. W. Sly Manufacturing Co.

James M. McWhirter, formerly southern works manager for Pennsylvania Salt Manufacturing Co., has been appointed manager of the Wyandotte Works. Mr. McWhirter replaces *G. A. Nelson*, who is being assigned to general engineering and consultative work in connection with the company's current expansion and plans for future developments.

Detroit Testing Laboratories has announced the appointment of *Eugene V. Ivanso* as director of metallurgical engineering and research.

Appointment of *L. A. Dixon, Jr.* as vice president of Rockwell Manufacturing Co.'s Meter and Valve Div. has been announced by the company.

Merle E. Kremer, who for the past 11 years has been associated with the General Electric Co., has been appointed as assistant to the president, Allied Products Corp.

Recent staff changes have been an-

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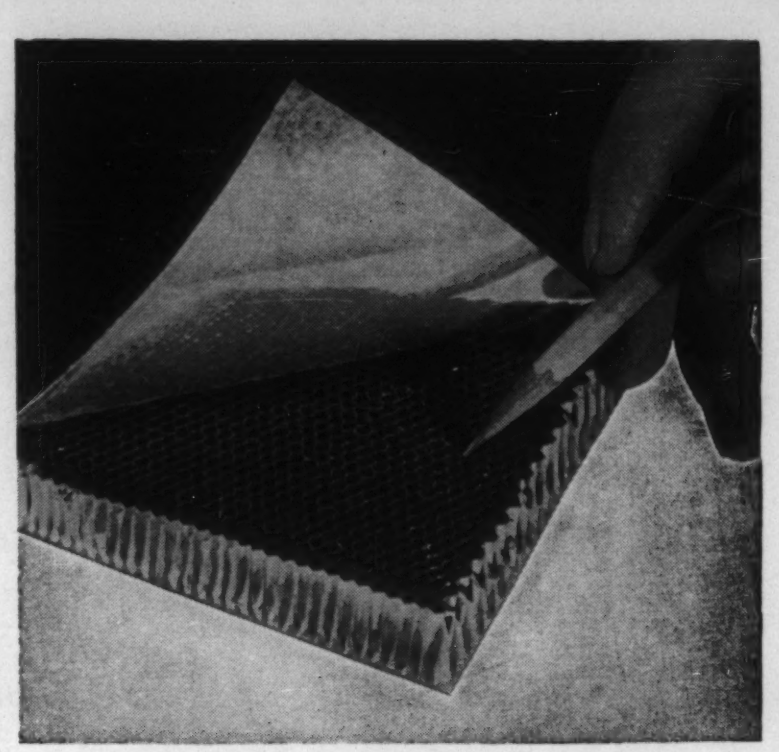

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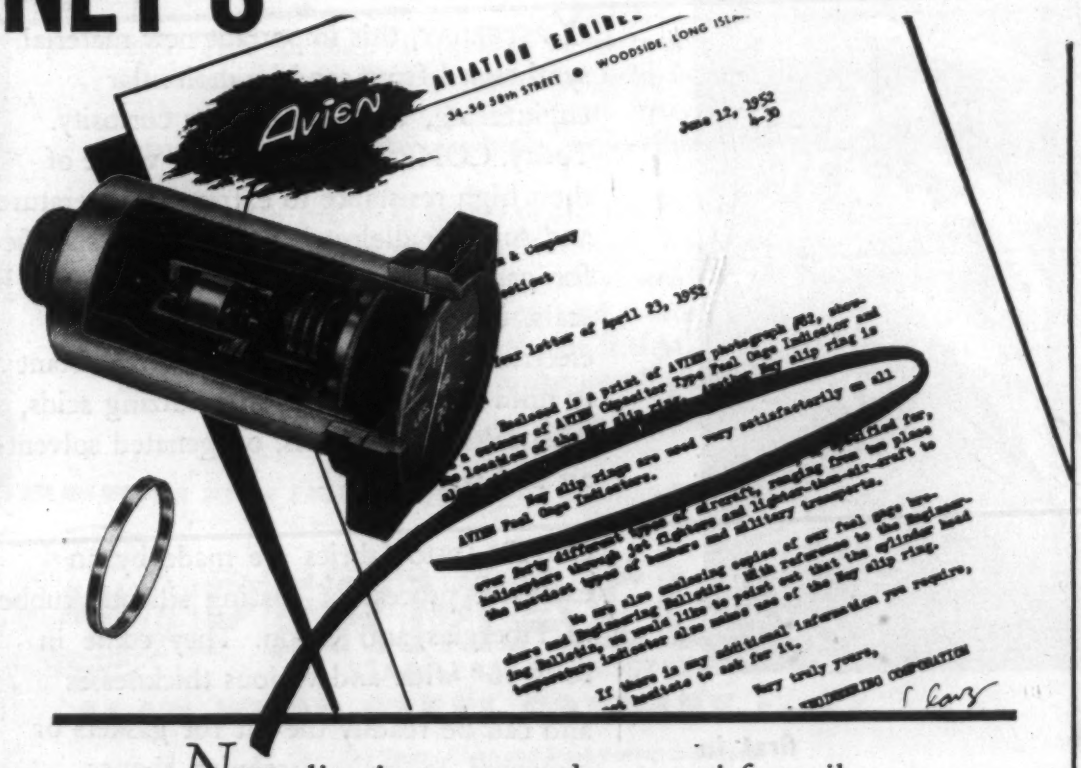
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News Digest

nounced by Clopay Corp. New additions to the laboratory staff include *Alfred L. Alk*, assistant technical director; *Wesley Shookevich, Sr.*, research chemist; *Eva Paulson, Robert Mauldin* and *Paul Imes* have assumed duties as junior research chemists.

The election of *R. C. Somerville* as vice president and a member of the board of the Plymouth Motor Corp., a subsidiary of Chrysler Corp., has been announced.

Edgar B. Speer has been appointed division superintendent of steel production at the Gary Works of U. S. Steel Co., according to a recent announcement. Mr. Speer succeeds *Oscar Pearson*, who will become assistant general superintendent at the Duquesne Works of the company. Appointment of *John E. Angle* as general superintendent of the Gary Sheet and Tin Mill has also been announced by the company. Mr. Angle succeeds *Charles A. Ferguson*, who is retiring.

Appointment of *Rexford C. Burnham* as Hydraulic Div. manager of the J. N. Fauver Co., Inc., has been announced.

Gustin-Bacon Manufacturing Co. has announced the appointment of *Edward A. McCabe* as manager of its New York division.

John Alico has joined Lake Erie Engineering Corp. as project engineer specializing in Lake Erie forging and extrusion press applications.

Everett S. Hoff has been appointed production manager—bars and tubes—for Columbia Steel & Shafting Co., according to a recent company statement. Mr. Hoff was formerly production manager for the Summerill Tubing Co. Div.

United States Plywood Corp. has announced the death of *Charles G. Yerkes*, president of Algoma Plywood and Veneer Co., and a leader in the plywood industry for many years.

News of Companies

In a move to further diversify its manufacturing operations, *H. K. Porter Co., Inc.* has acquired the *Watson-Stillman Co.* Operations at Watson-Stillman will continue under the direction of Edwin A. Stillman, president. The Watson-Stillman Fittings Div. will be operated as a division of H. K. Porter Co., Inc.

Ground has been broken on a 3-acre site in New Rochelle, N. Y., for the construction of a modern plant with 90,000

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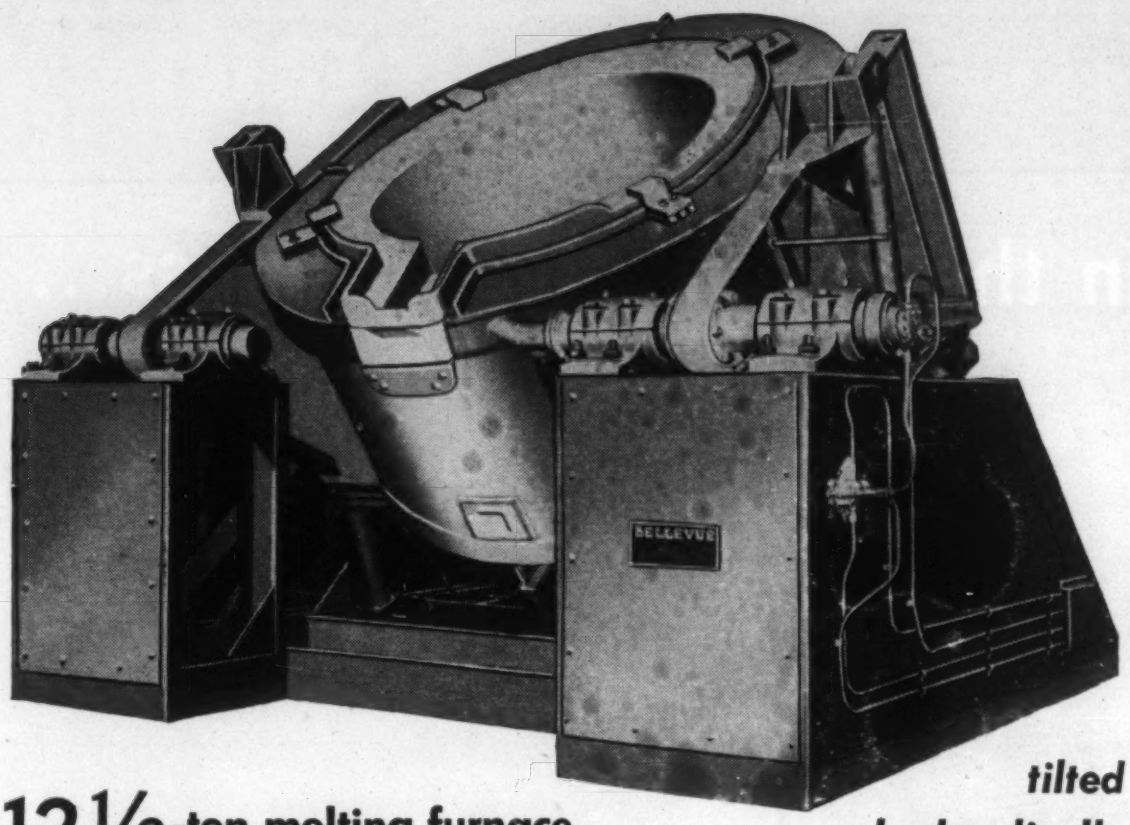

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Now, you can *accurately* test abrasion resistance of different specifications of ferrous metals that have been subjected to various heat treatments. The Taber Abraser tests flat or round specimens and gives numerical rating of wear resistance. This instrument is the recognized *standard* test for electroplated and oxidized coatings.

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Taber **INSTRUMENT CORPORATION**
109 Goundry Street, North Tonawanda, N. Y.

ALSO WRITE FOR FREE LITERATURE ON

★ V-5 Stiffness Gauge ★ Scratch and Toughness Testers

News Digest

sq ft of floor space by *Gries Reproducer Corp.*

A $440,000 expansion of testing facilities at the Army Ordnance Corps' Malta missile test station has been scheduled for 1953, according to a recent announcement from *General Electric Co.*, which operates the Malta Installation. The program calls for a new combustion laboratory, a water filtering plant, an additional water source, and additions to one of the control rooms.

Formation of a new Hooker subsidiary, *Hooker Chemicals Ltd.*, a British Columbia corporation, has been announced. The new company is acquiring a plant site of approximately 60 acres on Burrard Inlet in the District of North Vancouver, B. C.

The Electric Furnace Co. has announced the incorporation of a subsidiary company in Canada to be known as *Canefco Ltd.*, with headquarters in Toronto. New officers of the Canadian Co. are: D. E. Moody, president; K. U. Wirtz, vice president; H. E. Farintosh, secretary-treasurer.

The Atomic Energy Commission has selected The *Goodyear Tire & Rubber Co.* to be operating contractor for its Uranium-235 production plant soon to be built in Pike County, Ohio. When the $1,219,000,000 facility is completed, Goodyear Co. will be the principal employer there with a permanent working force of about 4000 persons.

An exclusive agreement has been reached by the *ChemoTec Div., Eutectic Welding Alloys Corp.*, and the *Ciba Co., Inc.* to exploit the processes developed from a fundamentally important line of new bonding materials. ChemoTec will manufacture and market under Ciba license, using its basic materials and processes.

As part of a long range general expansion program of *The Maytag Co.*, construction has been started on a new building which will double present facilities of the company's research and development div. The new addition is expected to be ready for occupancy in six months.

Surface Combustion Corp. has moved to new offices at 10333 W. McNichols Rd., Detroit 21.

Wilson Plastics, Inc. has announced a complete separation of *Midland Plastic Molding Co.* from the original Wilson plant. The Midland Plastic Molding Co. is moving into a modern and enlarged plant at 310 Boalt St., Sandusky, Ohio. Larry K. Peabody will head the new company as president.

Dormeyer Industries has announced that its new Chicago plant is now operating at full scale. Located at 3416-36 Milwaukee Ave., the structure encompasses approximately 44,000 sq ft of floor

Case History MM-102

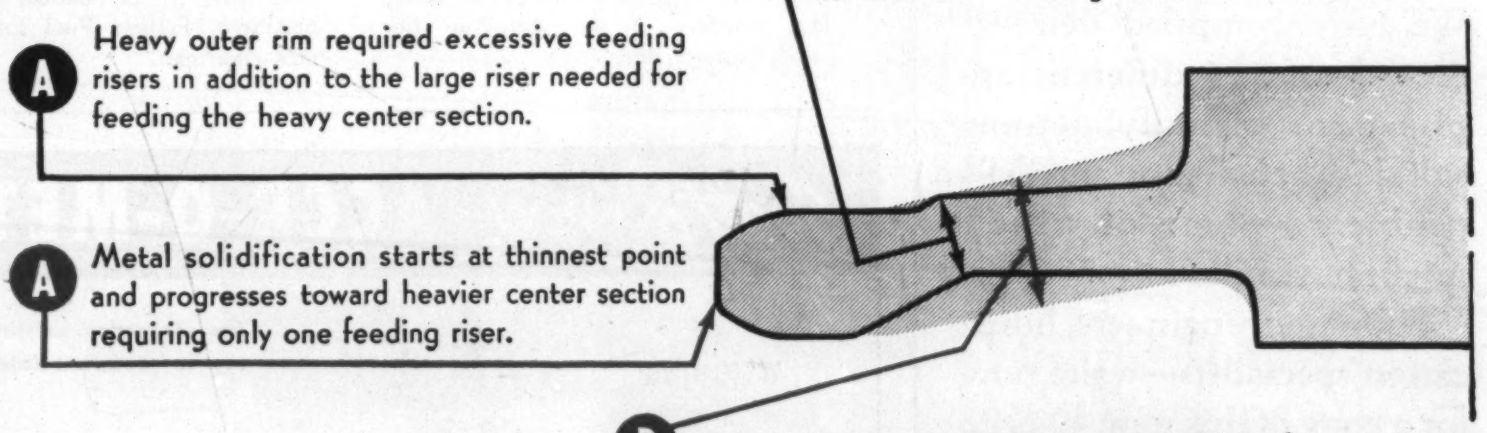
Here's what we mean by SUPERIOR ENGINEERED FOUNDRY PRODUCTS...

PROBLEM:

1. Conventional design of cast steel sprocket blank impaired proper directional solidification of the metal, causing uncontrolled shrinkage in the outer rim.
2. Assurance of delivery of sound castings was possible only through expensive non-destructive inspection of each blank.
3. Casting and machining losses were excessive.

OUR SOLUTION:

FOUNDRY ENGINEERED DESIGN to establish relationship of tooth, web and hub sections which would insure uniform directional solidification of the metal, place metal where needed most and minimize necessity for expensive inspection of each part.


A
Heavy outer rim required excessive feeding risers in addition to the large riser needed for feeding the heavy center section.
A
Metal solidification starts at thinnest point and progresses toward heavier center section requiring only one feeding riser.
B
Metal becomes solid at thin section first, cuts off all feeding action from heavier center section to outer rim — causing occasional shrink holes
B
Modified design gradually increases section from outer rim permitting metal to become solid progressively toward hub, eliminating shrink holes.

RESULT: 17.6% SAVINGS

1. Elimination of shrink holes in outer rim through proper directional solidification of the metal.
2. Elimination of need for expensive inspection of each part.
3. Reduced casting and machining costs.

BLACK LINES . . . ORIGINAL DESIGN
RED LINES . . . . . MODIFIED DESIGN

TOTAL COST OF PART REDUCED 17.6%

YOU TOO CAN GET SAVINGS LIKE THIS! CONSULT OUR PRODUCT DEVELOPMENT SECTION REGARDING YOUR PROBLEM . . . WHILE IT'S STILL ON THE DRAWING BOARD!

ENGINEERED FOUNDRY PRODUCTS
Since 1916

LET OUR FOUNDRY ENGINEERS HELP YOU CONSERVE CRITICAL MATERIALS

SUPERIOR STEEL AND MALLEABLE CASTINGS CO.

BENTON HARBOR, MICHIGAN, U. S. A.

Have you heard about

THE LUBRICANT OF MANY USES

Moly-sulfide

A LITTLE DOES A LOT

In the shop—

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Moly-sulfide **is a solid-film lubricant, highly successful in applications involving extreme pressures, high velocity, fretting, elevated temperatures and other difficult frictional conditions. We have compiled detailed records of 154 different applications of molybdenum sulfide to actual shop and field problems—some of which might be similar to your own.**

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MOLY

MM-11 MS4-A

News Digest

space, plus a 50- by 100-ft adjacent vacant lot.

Pressed Steel Car Co. has announced that it has made arrangements to acquire the *Axelson Manufacturing Co.* of Los Angeles and the *Umpqua Plywood Corp.* of Eugene, Ore.

A 50% production increase and more uniform curing of high-speed grinding wheels molded of abrasives bonded with Bakelite phenolic resins are the goals of a recently completed modernization and expansion program at *Simonds Abrasive Co.*

Kelite Products, Inc. has completed its new factory and sales offices at Berkeley Heights, N. J.

News of Societies

The annual Doehler Award for "The Outstanding Achievement Contributing to the Advancement of the Die Casting Industry" was recently presented to David Laine, secretary of the *American Die Casting Institute, Inc.*

The American Society for Testing Materials has announced the election of Robert J. Painter as executive secretary and of Raymond E. Hess as associate executive secretary and editor in chief.

L. F. Hansen has been appointed director of industrial relations for the *National Metal Trades Assn.*

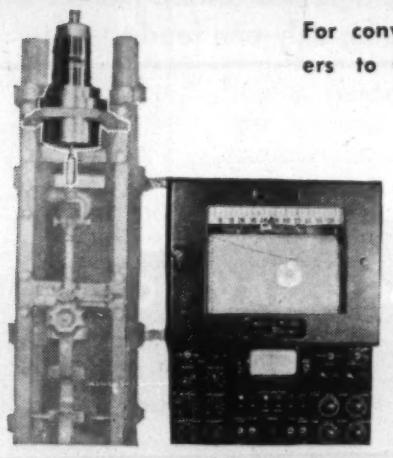
The 100th Chapter of *The American Society of Tool Engineers,* this year celebrating its 20th anniversary, was recently chartered in Memorial Hall in Athol, Mass. The new chapter will be known as the *North Central Massachusetts Chapter.*

Organization of the advisory committee for the 11th International Heating and Ventilating Exposition has been completed. The display, which is to be held at the International Amphitheatre in Chicago, Jan. 26-30, 1953, has expanded from the huge first floor and arena into the entire North Wing of the second floor. The exposition is being held under the auspices of the *American Society of Heating and Ventilating Engineers* in conjunction with the Society's 59th annual meeting.

New officers inducted at the regular fall meeting of the *Gas Appliance Manufacturers Association's* Industrial Gas Equipment Div. are: F. C. Schaefer, sales manager, American Gas Furnace Co., chairman; J. H. Sands, executive vice president, Eclipse Fuel Engineering Co., vice chairman.

Scott's NEW "ACCR-O-METER"

WEIGHING SYSTEM FOR CONSTANT-RATE-OF-EXTENSION TESTING



For converting existing Scott Testers to Constant-Rate-of-Extension

TESTS BOTH HIGH- AND LOW-ELONGATION MATERIALS

Do you have this problem . . .

TO MAGNIFY THE ENTIRE STRESS-STRAIN CURVE— OR ANY PORTION THEREOF

Scott's new Accr-O-Meter makes this possible—to virtually an infinite degree. With it you can magnify any portion of the stress-strain curve in either direction, enabling you to evaluate with great precision the troublesome point. This newest development incorporates an electric weighing system free from inertia, accurate beyond belief. Wide versatility, testing various materials, or making various tests on same material—up to 2,000 lbs. tensile.

LITERATURE UPON REQUEST

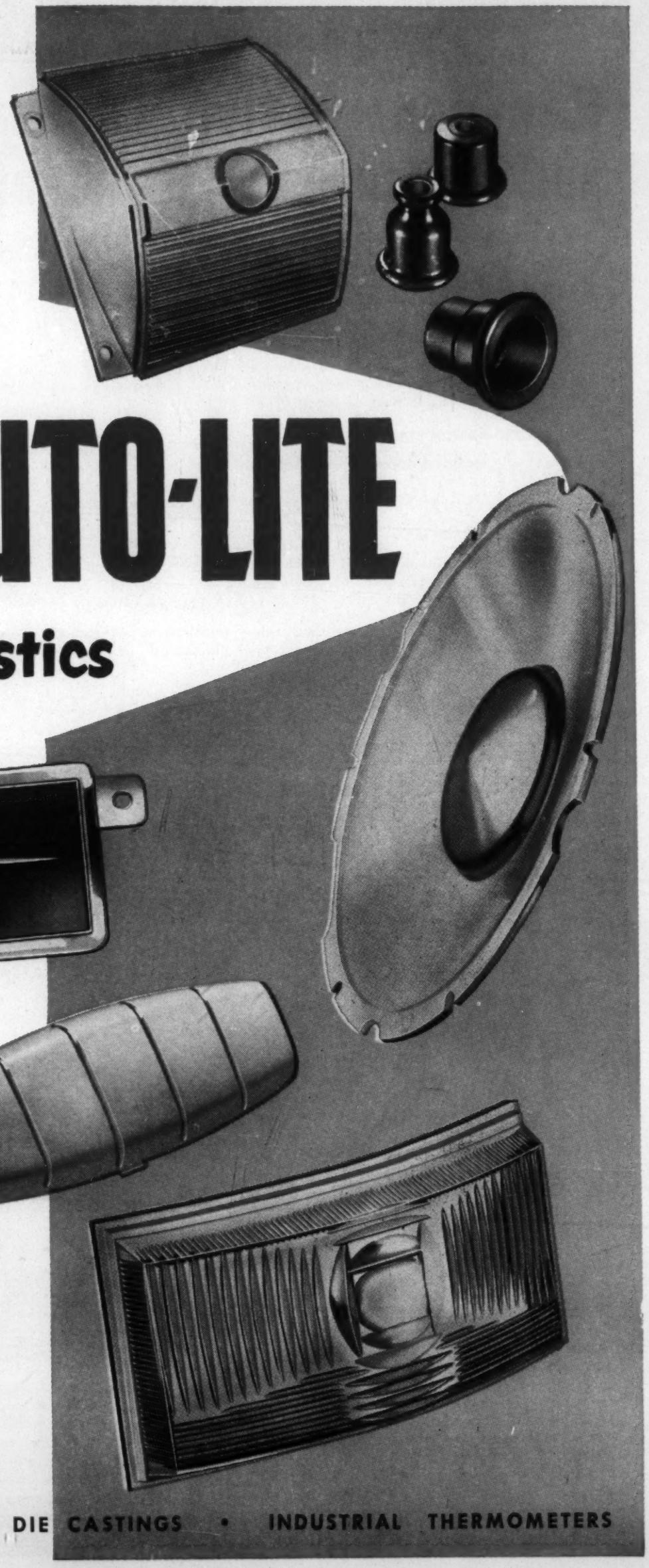
SCOTT TESTERS, INC.

65 Blackstone St.
Providence, R. I.

Scott Testers — Standard of the World

You're always right with AUTO-LITE

Plastics



• Plastics and plastic-metal combinations are opening new fields in design as illustrated by these few of many assemblies made by Auto-Lite. Here under one roof at Auto-Lite's great Bay Manufacturing Division in Bay City are the technical skills and production capacity for a new art rendered in plastics. The artistic skill of Auto-Lite's Art and Style Division is available on matters of design and development. Address inquiries to:

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Bulletin No. 21

UNUSUAL

Non-Destructive Testing and Measuring Instruments

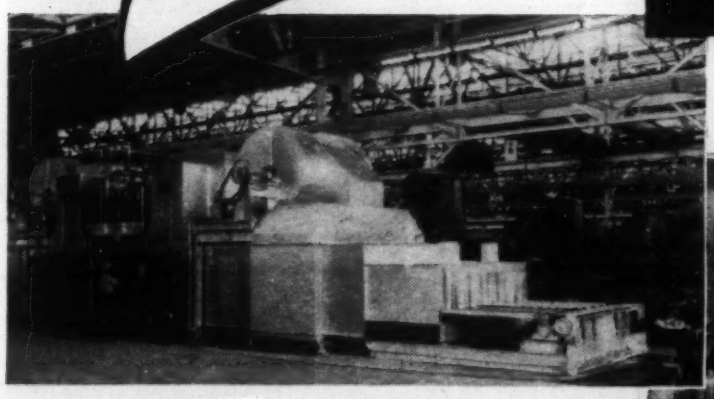
- **ELECTRONIC MICROMETER—**
  - .... *Direct* measurements to .000020"—*not* a comparator
  - .... Measures without pressure on work—eliminates "feel"
  - .... Measures *any* material, hard or soft
- **ULTRASONIC METROSCOPE—**
  - .... Measures wall thicknesses *from one side only*
  - .... Detects internal defects *non-destructively* in metals and other materials
  - .... Inspects for lack of bond
- **AUTOMATIC CYCLOGRAPH—**
  - .... Non-destructive, high speed sorting of metals and metal parts by analysis—heat treatment—hardness—depth of case or decarb, etc.
  - .... Unscrambles raw material or finished parts mixups, but quick!
- **MICROHM METER—**
  - .... Measures down to 1 microhm (.000001 ohm)
  - .... Checks resistances of materials
  - .... Tests "cleanliness" of aluminum sheet prior to welding

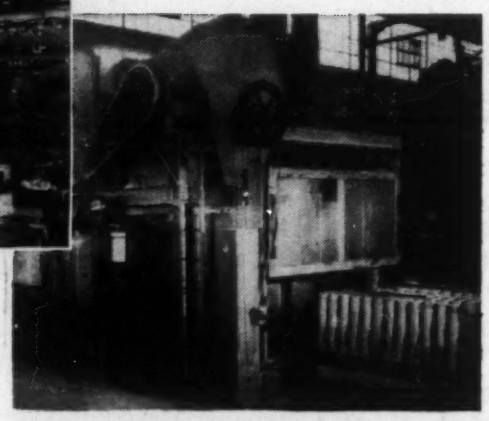
These and other unusual non-destructive testing instruments are illustrated in Bulletin No. 21

J. W. DICE COMPANY **ENGLEWOOD, N. J.**

ROCKWELL BUILDS 'EM BETTER

for Every Heat Treatment of Aluminum and Its Alloys





The many millions of dollars invested by the aluminum industry in Rockwell Furnaces and Gehnrich Ovens continue to pay off handsomely in low cost, high quality melting, annealing, aging, normalizing, solution heating and other required heating processes.

Rockwell batch type and continuous automatic furnaces and ovens, gas, oil or electric, are being pushed hard these days in the expanded production of ingots, billets, cakes, forgings, extrusions, plate, sheet, foil, strip, wire and castings.

Leading aluminum and magnesium plants—and many small ones, too—are Rockwell-equipped for better heating. How about yours?

W. S. ROCKWELL CO. • 2082 Eliot St., Fairfield, Conn.

Meetings and Expositions

AMERICAN STANDARDS ASSOCIATION, annual meeting. New York. Nov. 25, 1952.

AMERICAN SOCIETY FOR QUALITY CONTROL, Mid-West conference. Indianapolis. Nov. 20-21, 1952.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, annual meeting. New York. Nov. 30 - Dec. 5, 1952.

NATIONAL POWER SHOW. New York. Dec. 1-6, 1952.

SOCIETY FOR EXPERIMENTAL STRESS ANALYSIS, annual meeting. New York. Dec. 3-4, 1952.

AMERICAN INSTITUTE OF MINING & METALLURGICAL ENGINEERS, electric furnace steel conference. Pittsburgh. Dec. 4-6, 1952.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, annual meeting. Cleveland. Dec. 7-10, 1952.

INSTITUTE OF THE AERONAUTICAL SCIENCES, Wright Brothers lecture. Washington, D. C. Dec. 17, 1952.

SOCIETY OF AUTOMOTIVE ENGINEERS, annual meeting. Detroit. Jan. 12-16, 1953.

PLANT MAINTENANCE SHOW AND CONFERENCE. Cleveland. Jan. 19-22, 1953.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, winter general meeting. New York. Jan. 19-23, 1953.

MALLEABLE FOUNDERS' SOCIETY, general meeting. Cleveland. Jan. 23, 1953.

AMERICAN SOCIETY OF HEATING & VENTILATING ENGINEERS, international heating and ventilation exposition. Chicago. Jan. 26-30, 1953.

INSTITUTE OF THE AERONAUTICAL SCIENCES, annual meeting. New York. Jan. 26-30, 1953.

AMERICAN INSTITUTE OF MINING & METALLURGICAL ENGINEERS, annual meeting. Los Angeles. Feb. 16-19, 1953.

AMERICAN SOCIETY FOR TESTING MATERIALS, spring meeting. Detroit. Mar. 2-6, 1953.

SOCIETY OF AUTOMOTIVE ENGINEERS, passenger car, body and materials meeting. Detroit. Mar. 3-5, 1953.

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION, winter meeting. Chicago, Mar. 8-12, 1953.

NATIONAL ASSOCIATION OF CORROSION ENGINEERS, annual conference. Kansas City, Mar. 15-19, 1953.

NATIONAL ASSOCIATION OF CORROSION ENGINEERS, protective coatings symposium. Chicago. Mar. 16-20, 1953.

AMERICAN SOCIETY FOR METALS, Western metal congress and exposition. Los Angeles. Mar. 23-27, 1953.